



# Certificate of Grant of Patent

Patent Number: GB2369294  
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William Tippet

*This is to Certify that, in accordance with the Patents Act 1977,*

a Patent has been granted to the proprietor(s) for an invention entitled  
**"Carpet tile"** disclosed in an application filed **22 November 2001**.

Dated 30 October 2002



Alison Brimelow  
Comptroller General of Patents,  
Designs and Trade Marks  
UNITED KINGDOM PATENT OFFICE





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US 3772219 A

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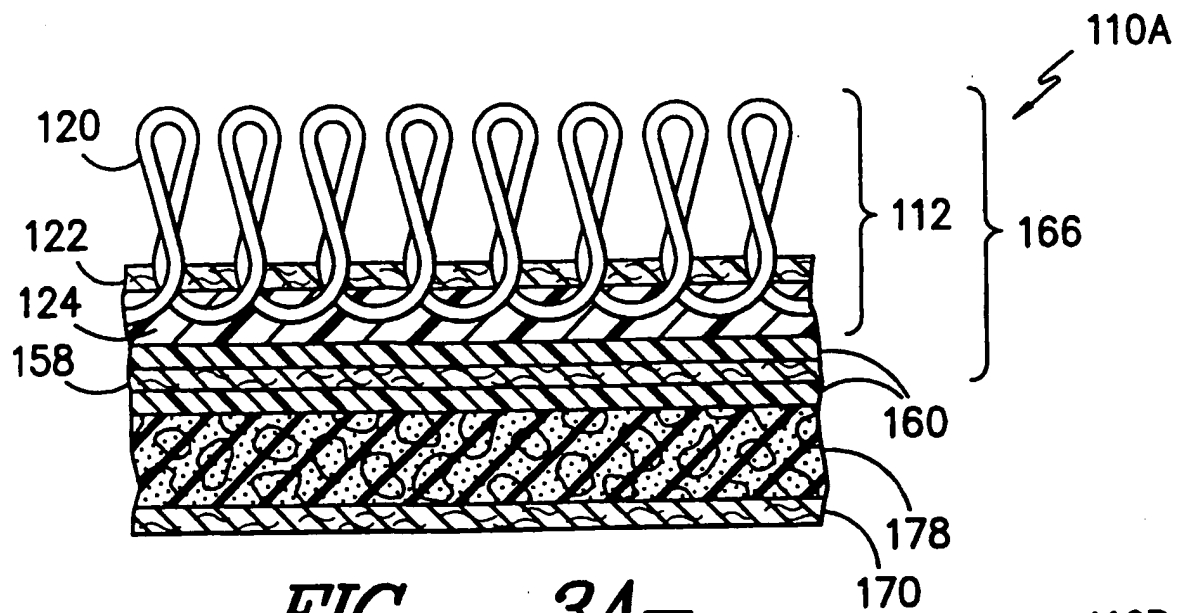


FIG. -3A-

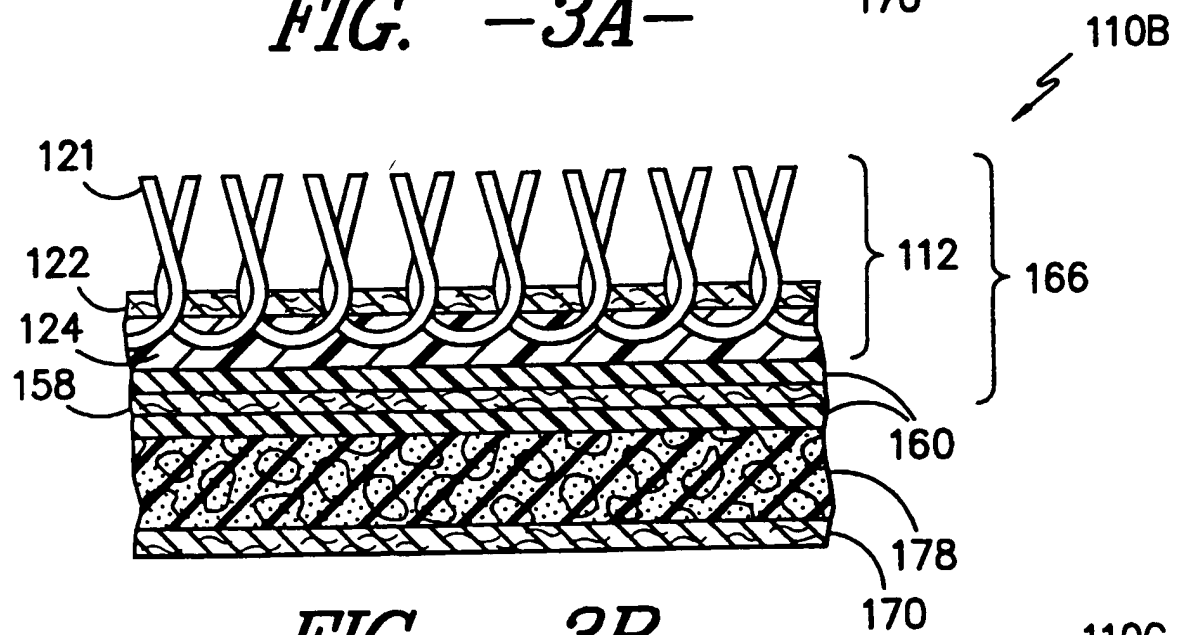
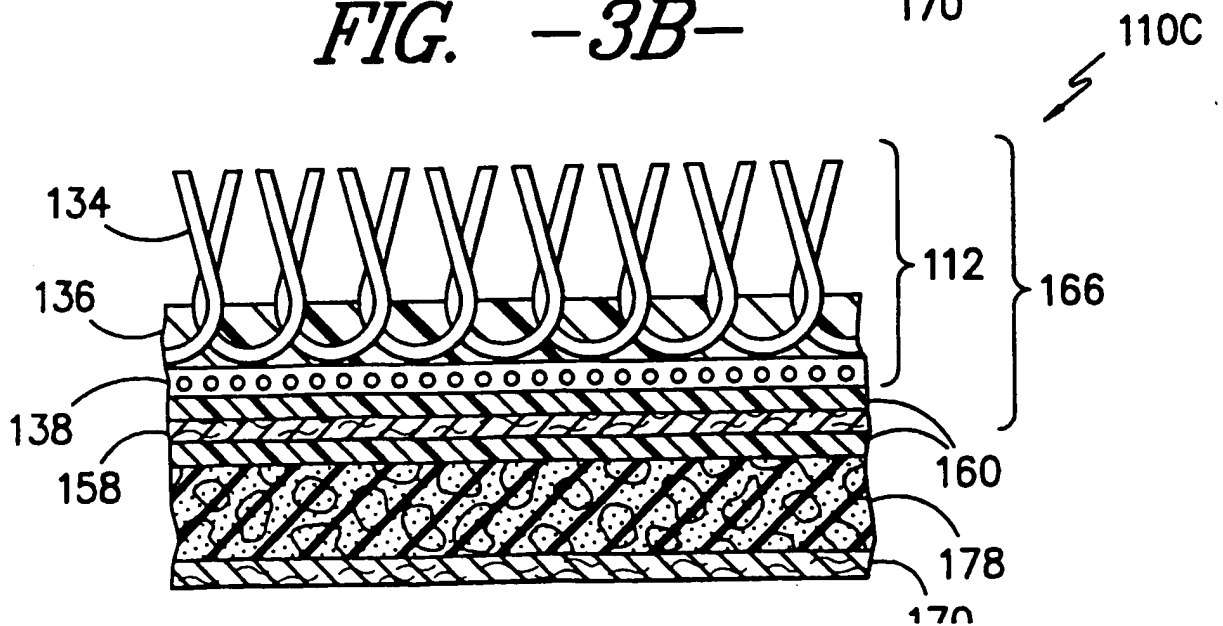
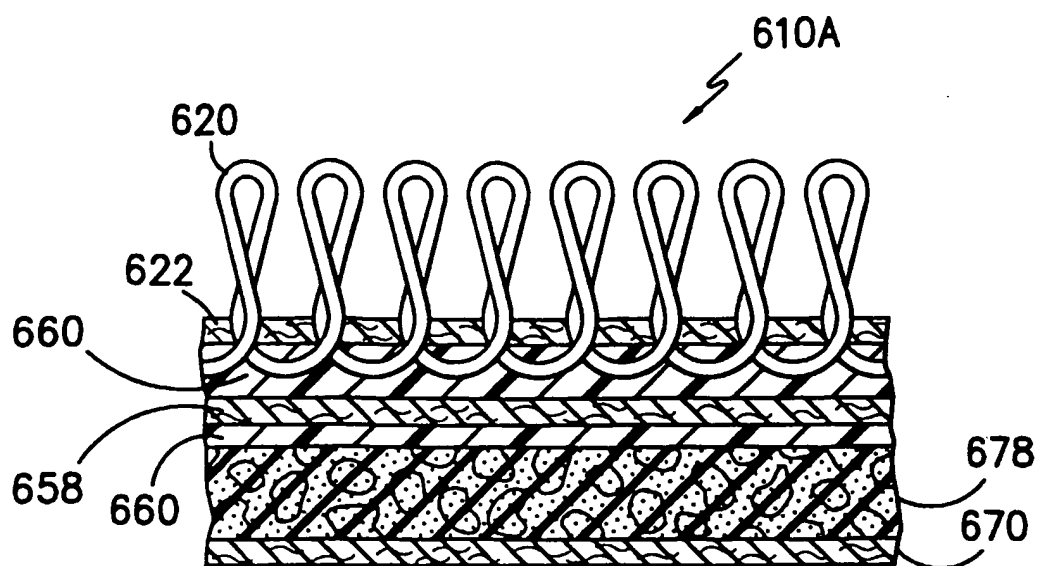
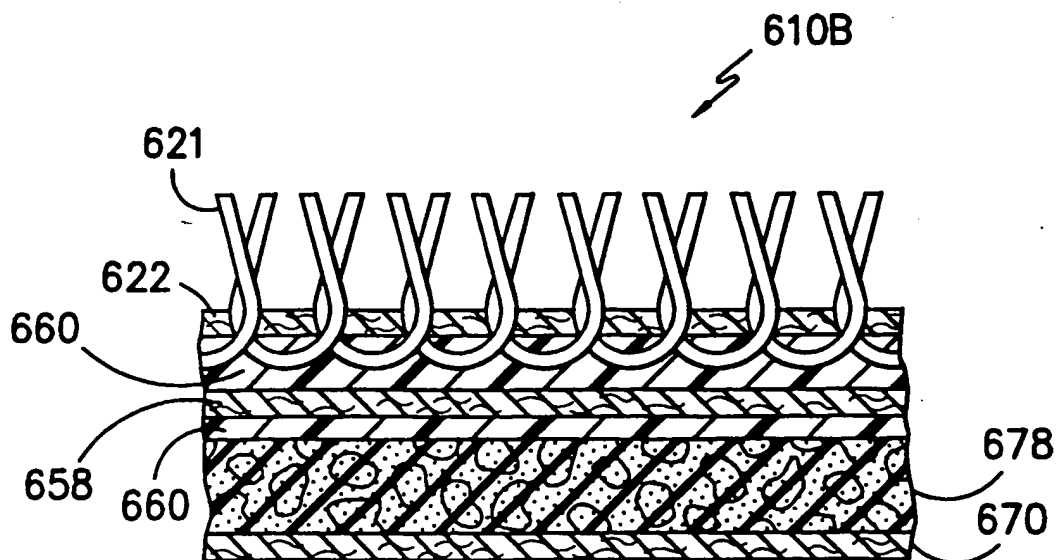


FIG. -3B-

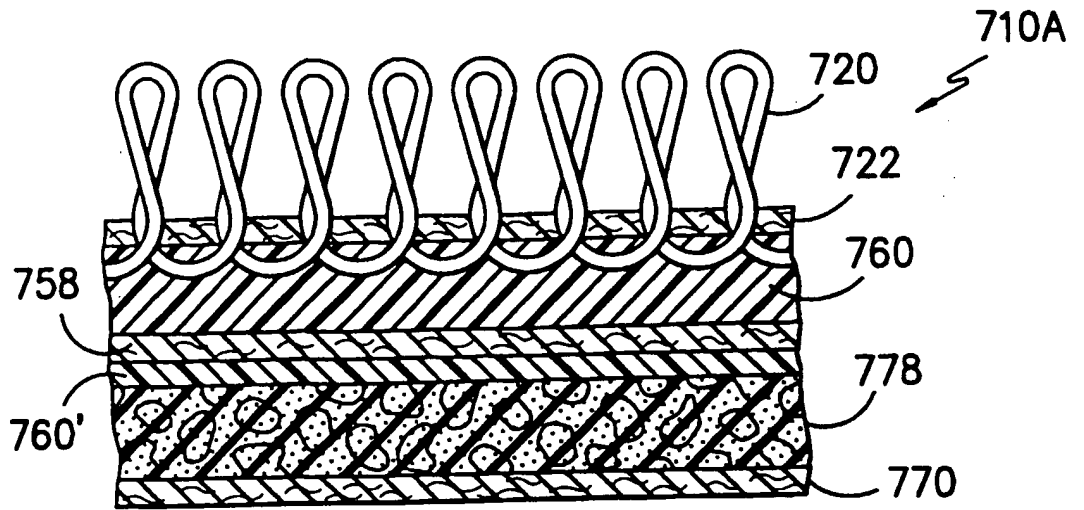




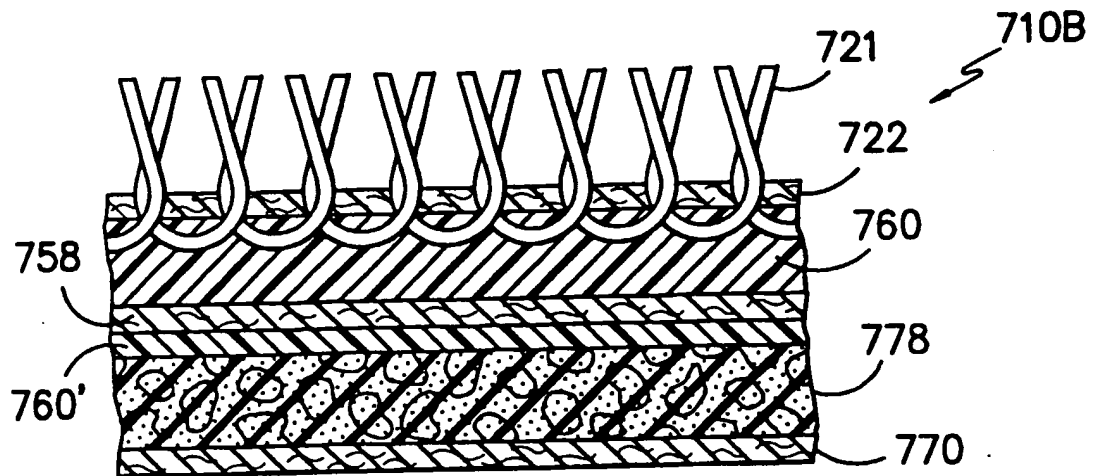
*FIG. -6A-*



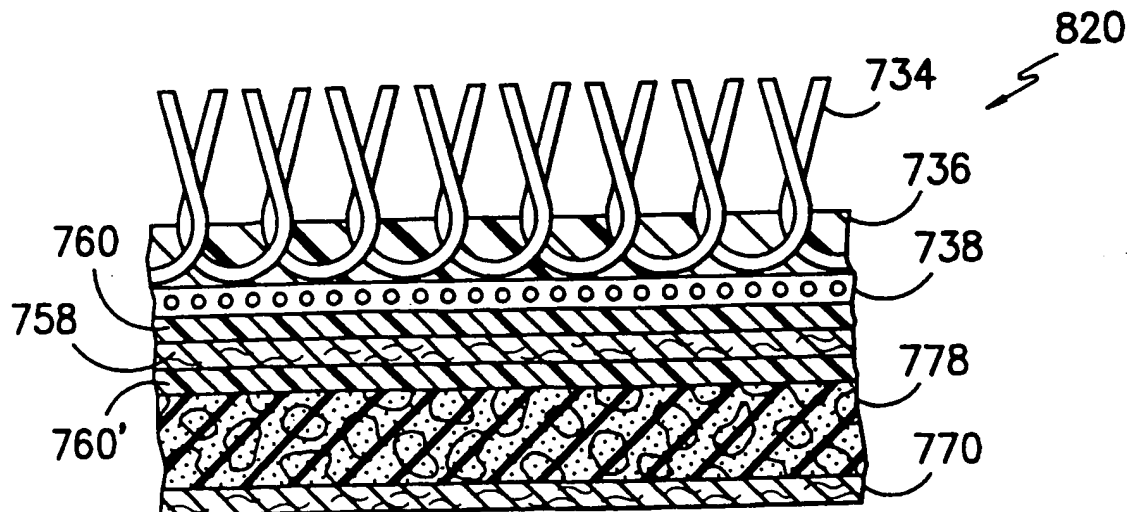
*FIG. -6B-*

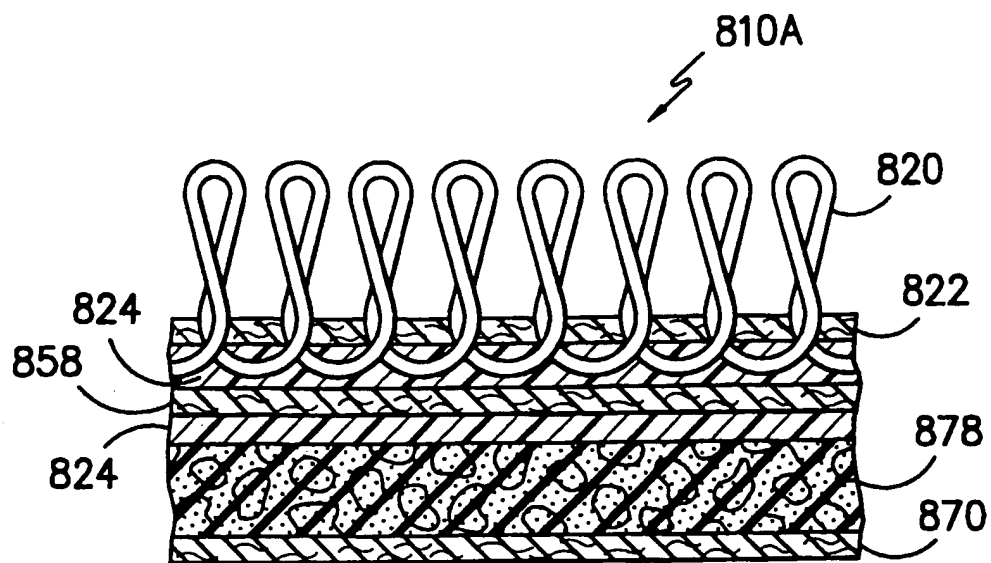


*FIG. - 7A-*

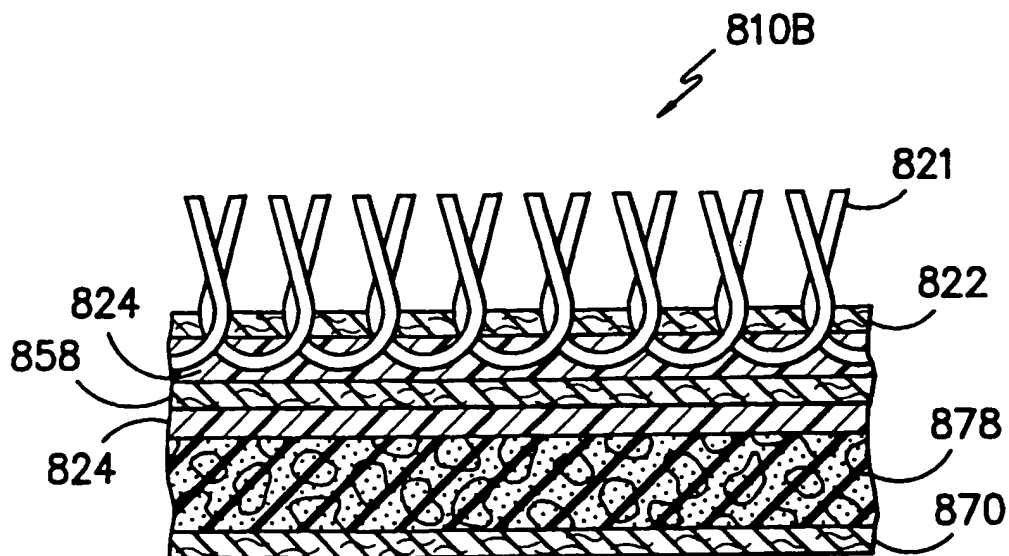


*FIG. - 7B-*





*FIG. -8A-*



*FIG. -8B-*

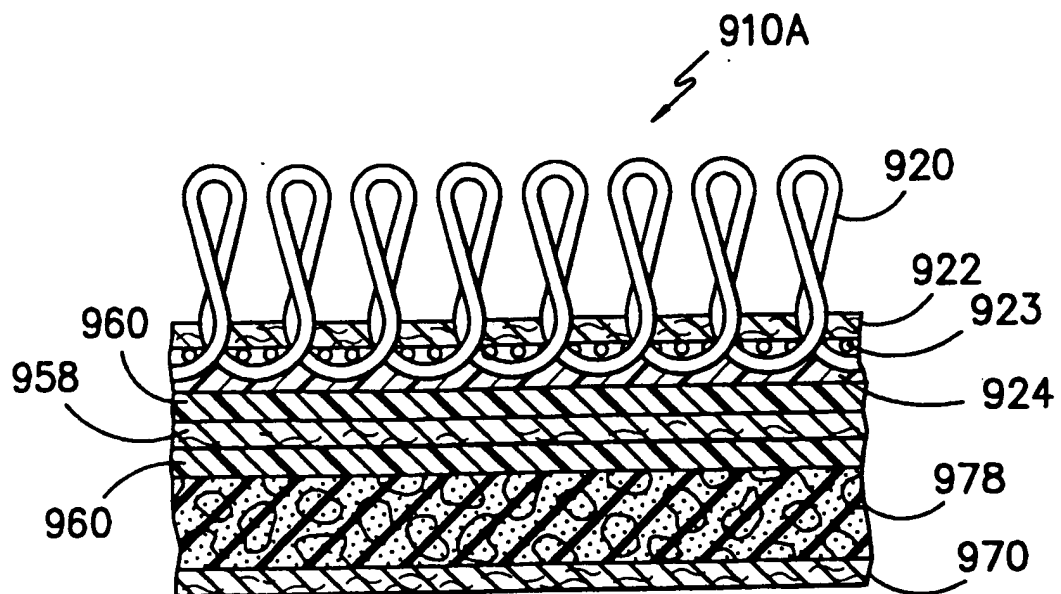


FIG. -9A-

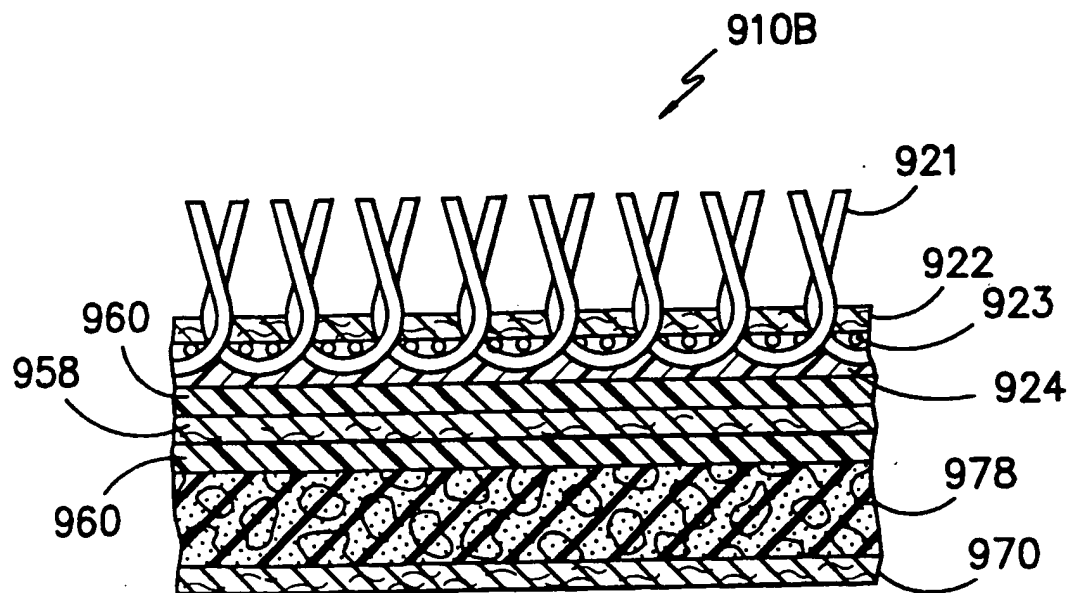
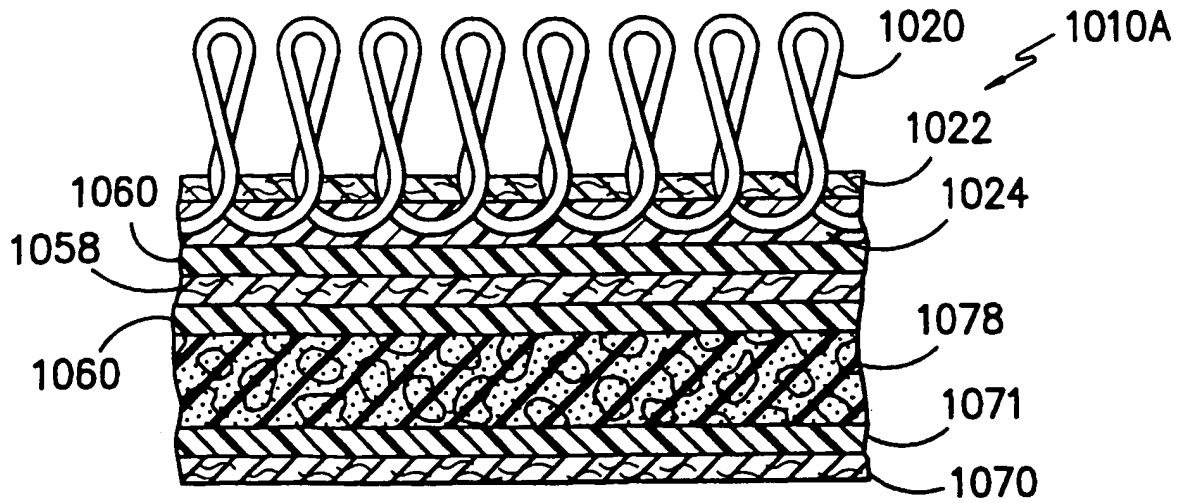
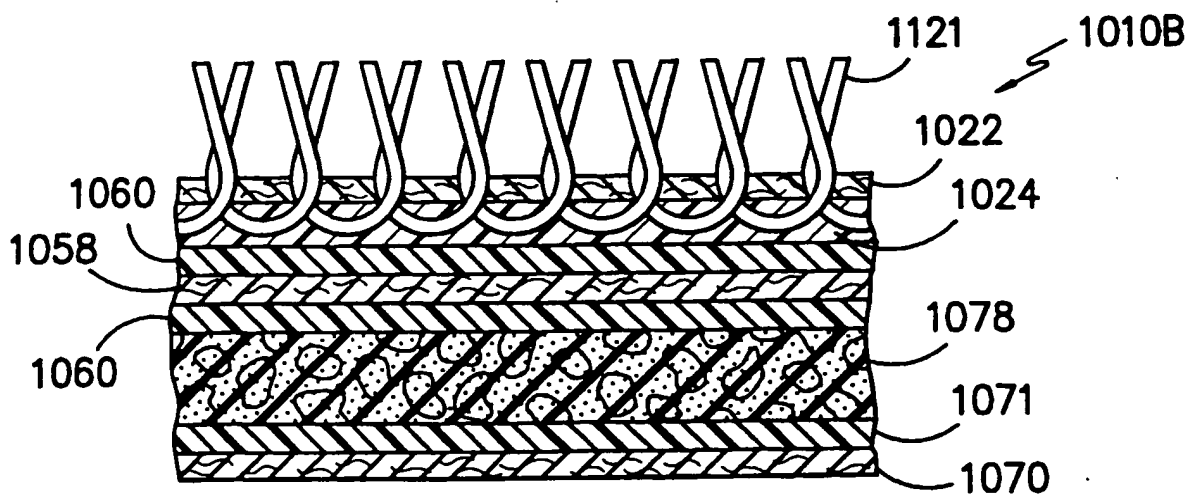


FIG. -9B-

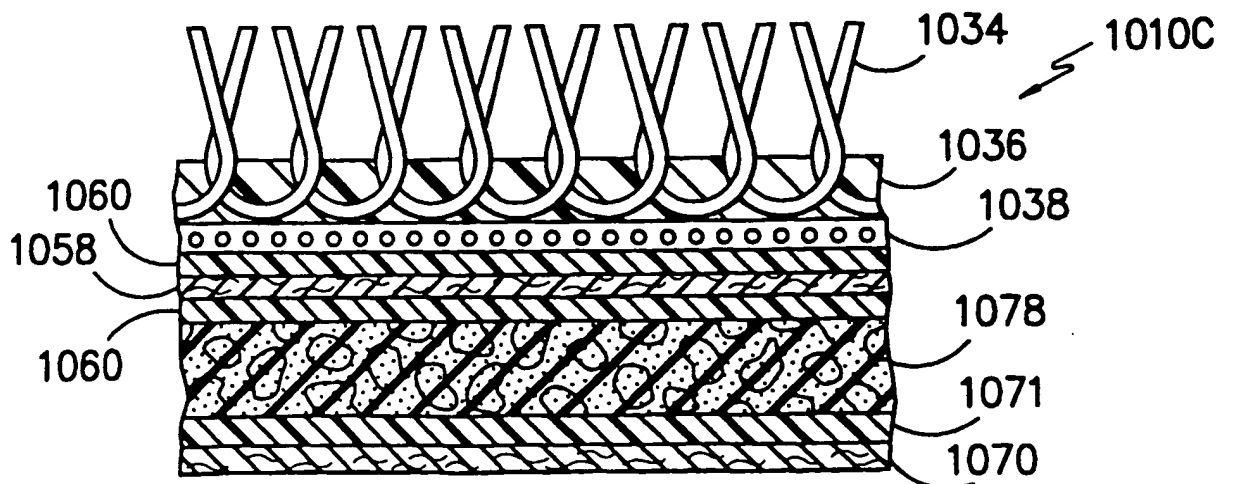
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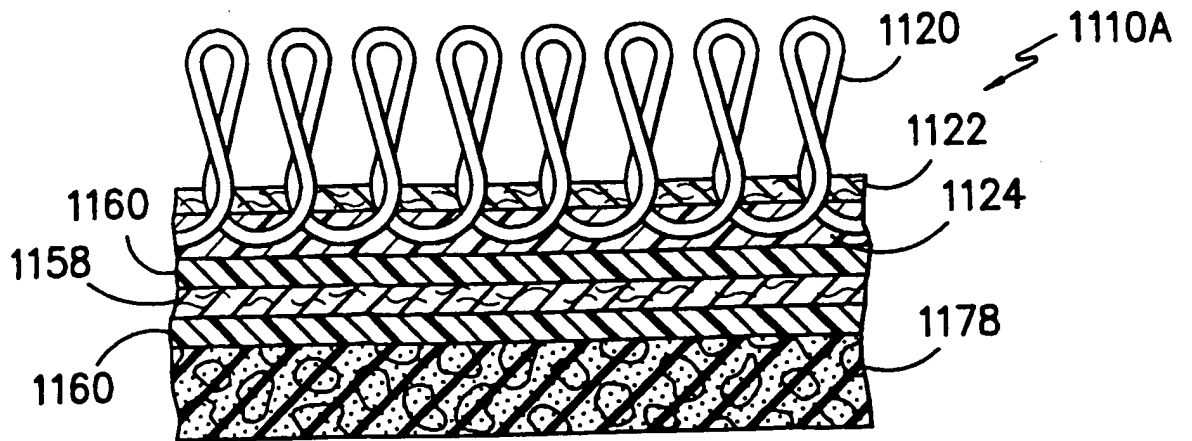
*FIG. -10A-*



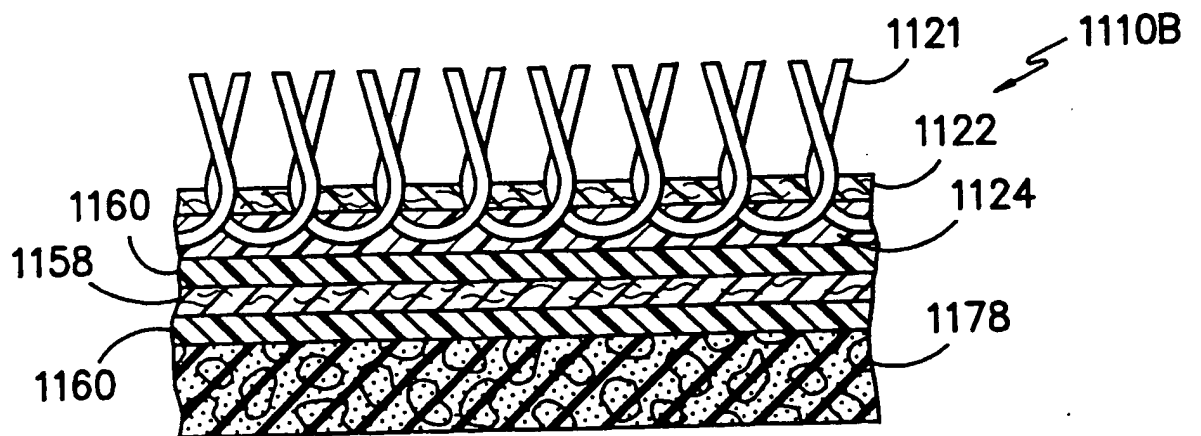
*FIG. -10B-*



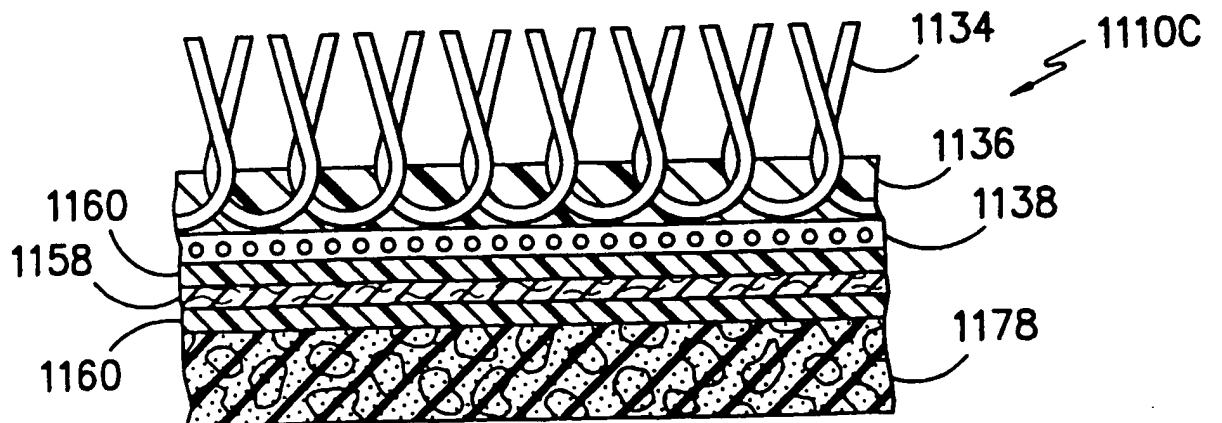
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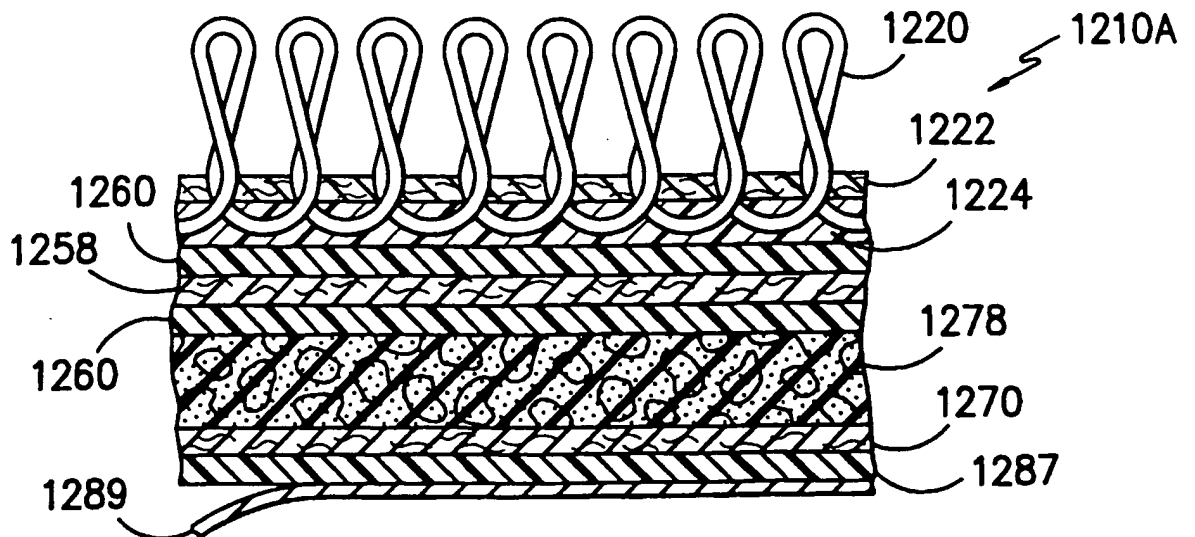


*FIG. -11A-*

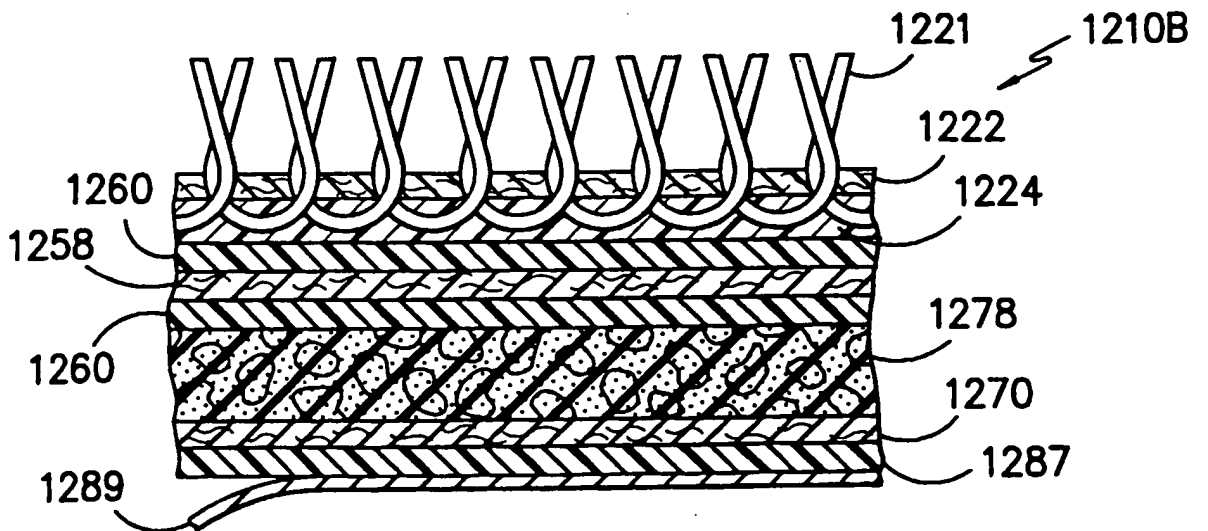


*FIG. -11B-*

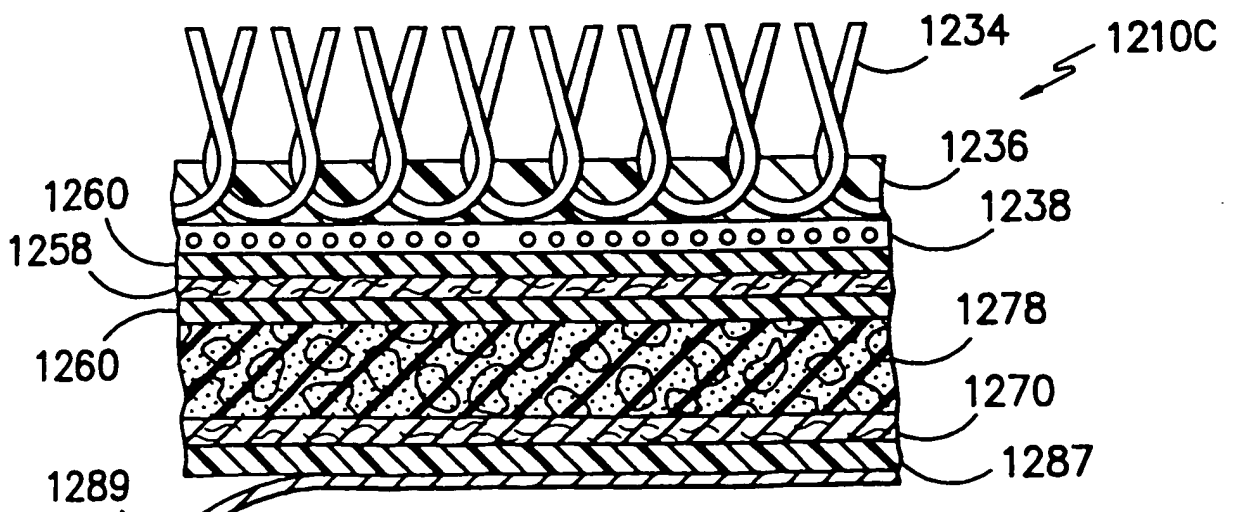




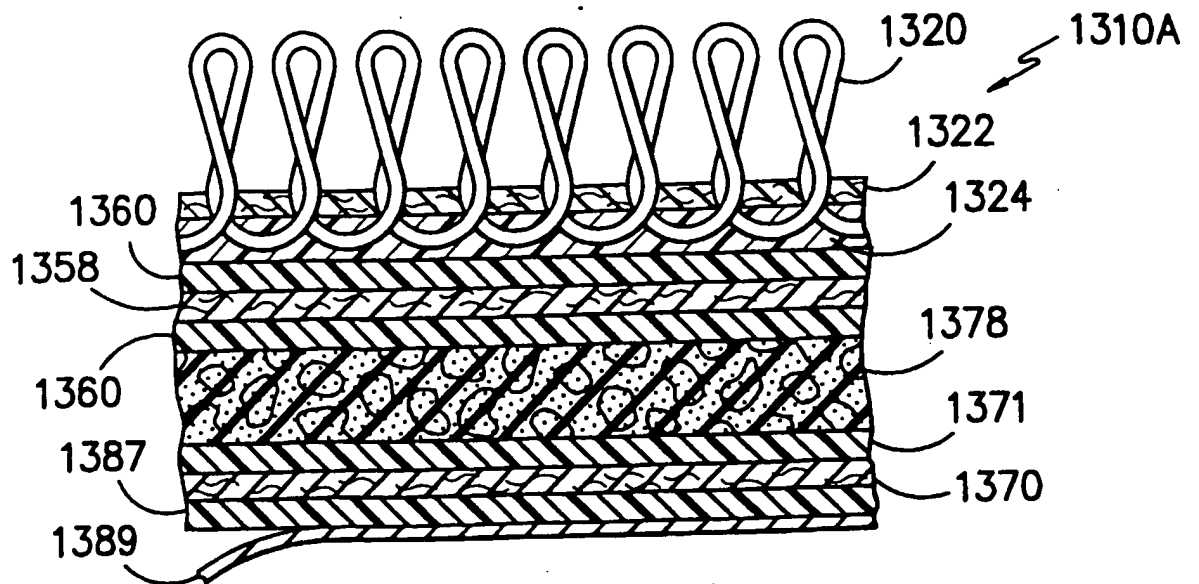
*FIG. -12A-*



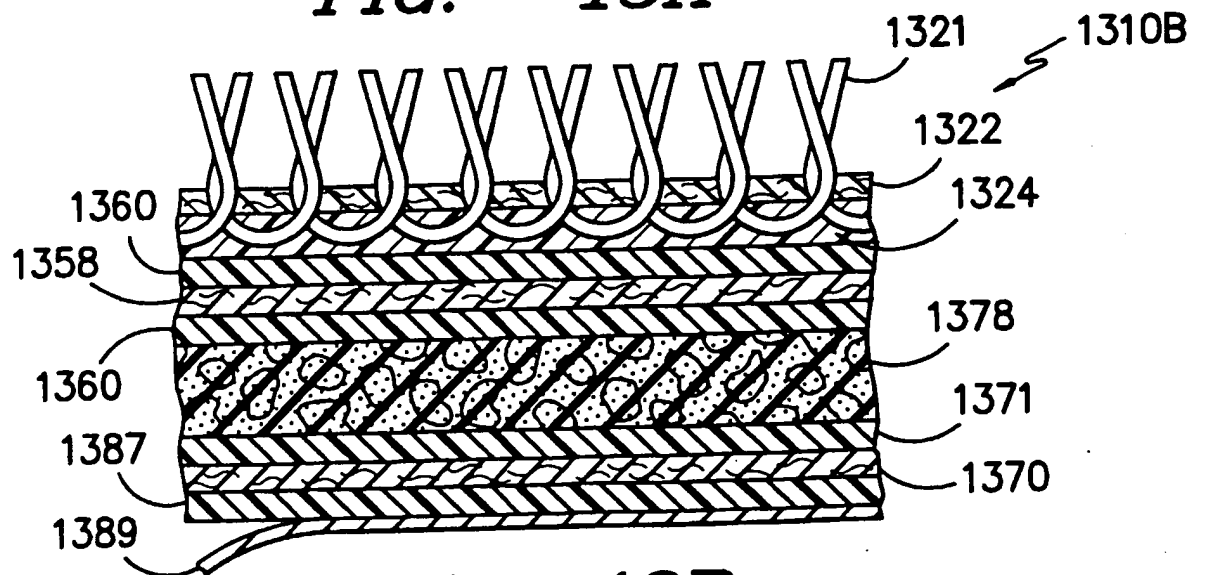
*FIG. -12B-*



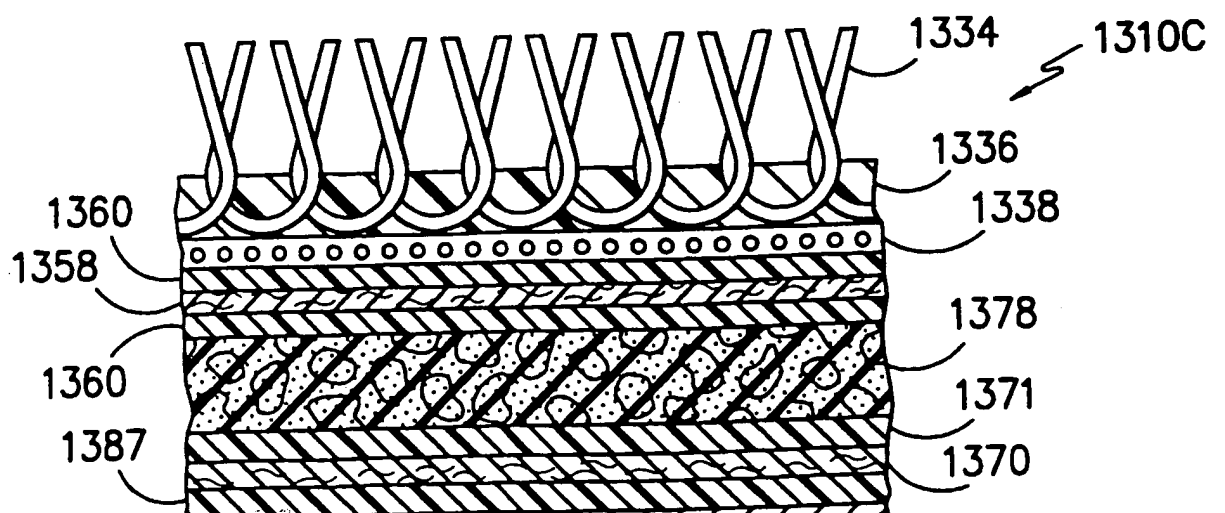
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*FIG. -13A-*



*FIG. -13B-*



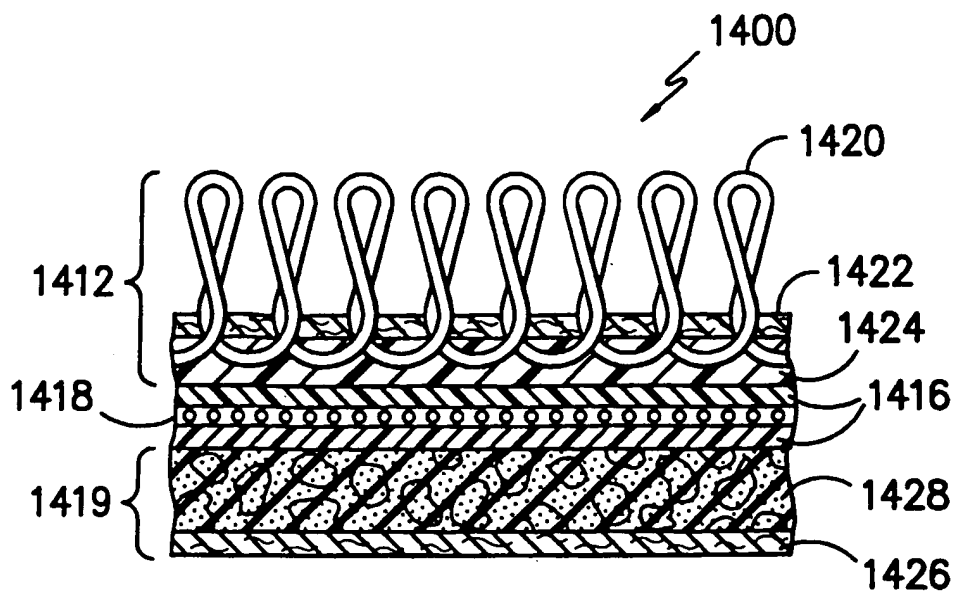


FIG. -14A-

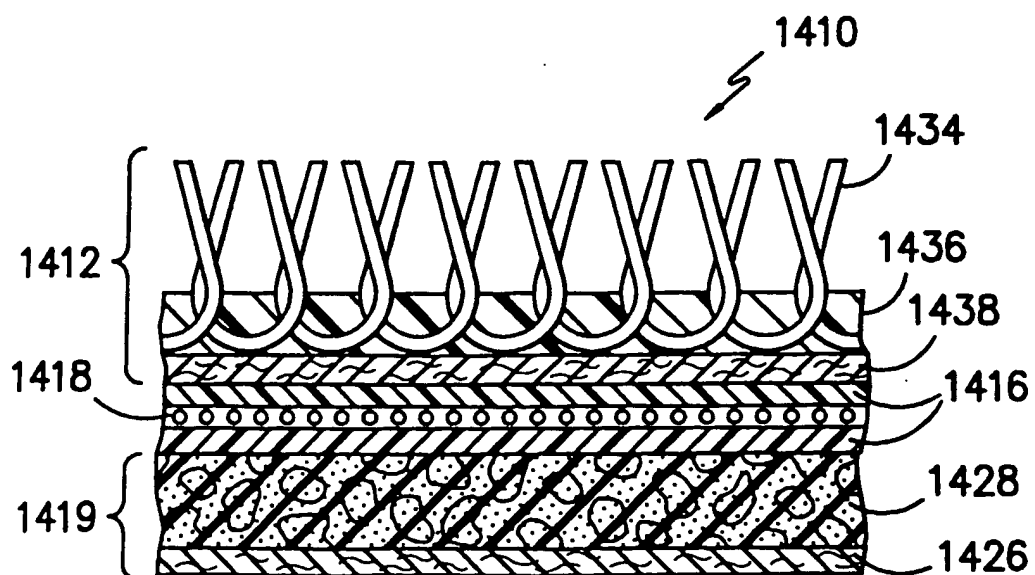
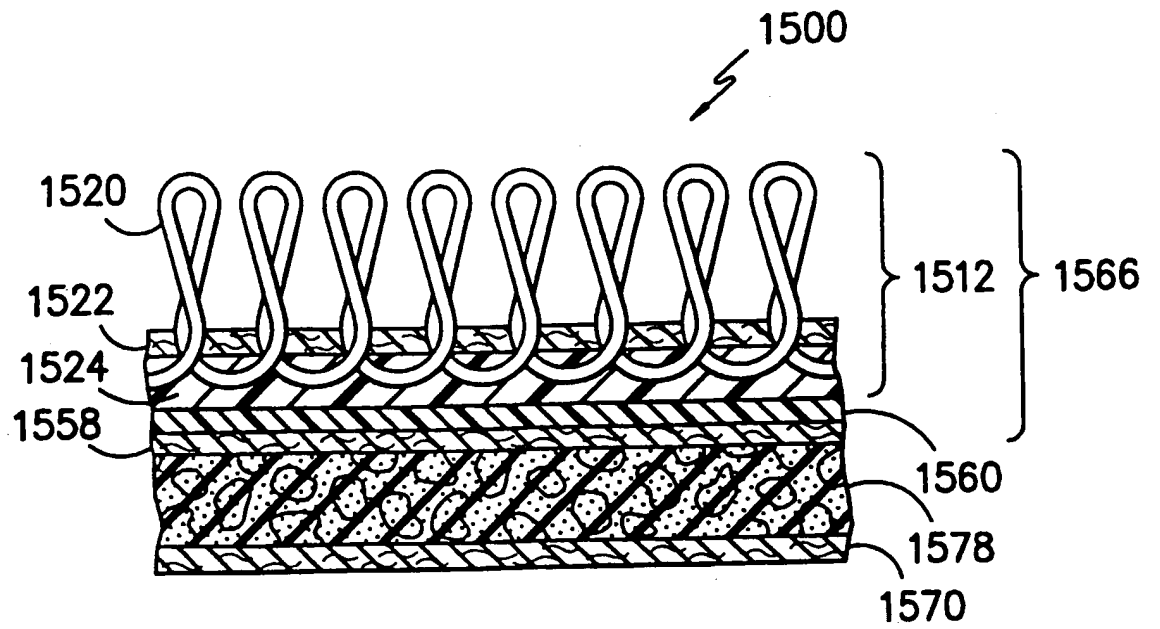
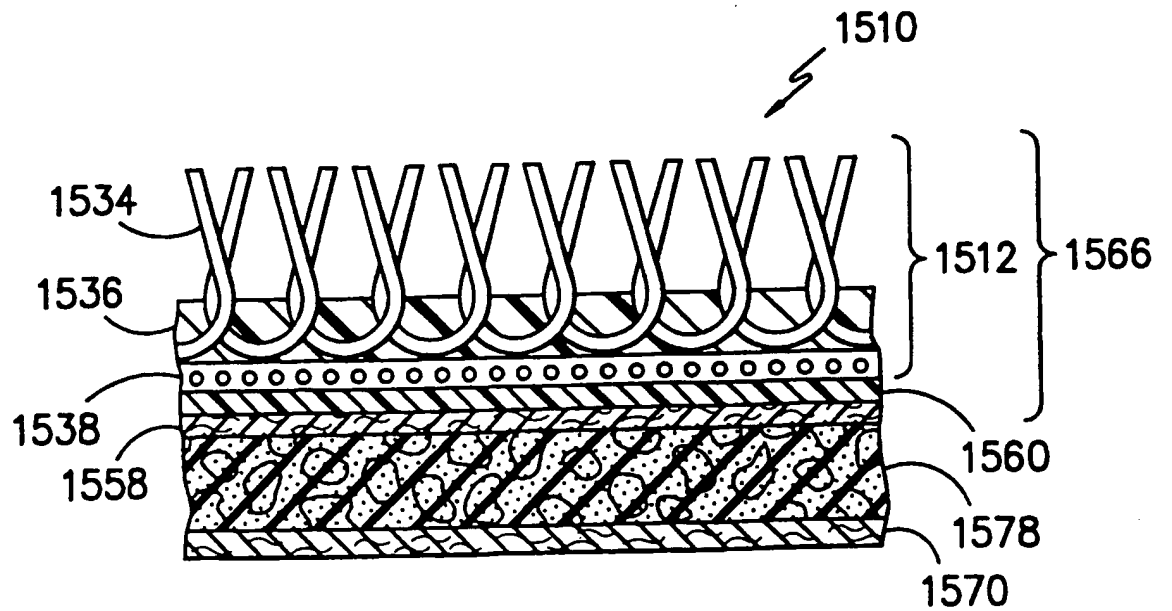


FIG. -14B-

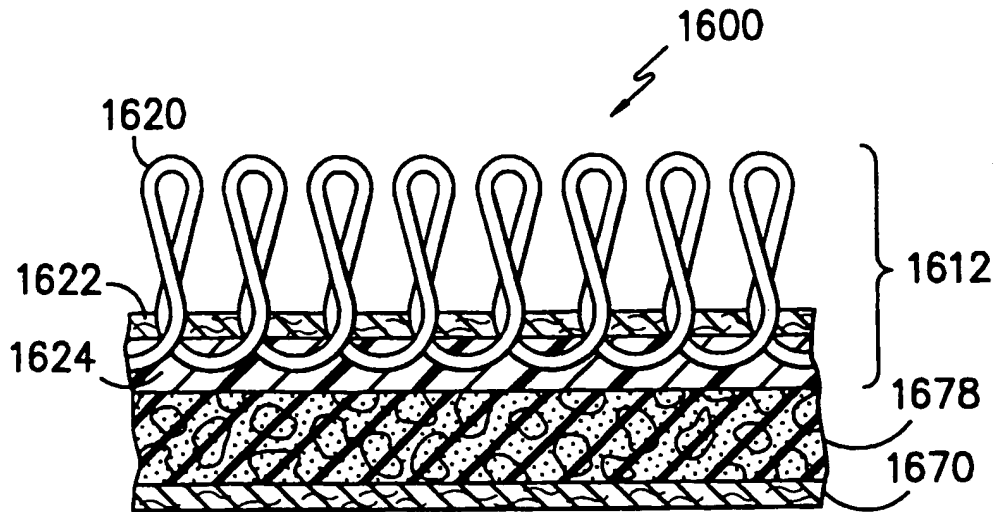
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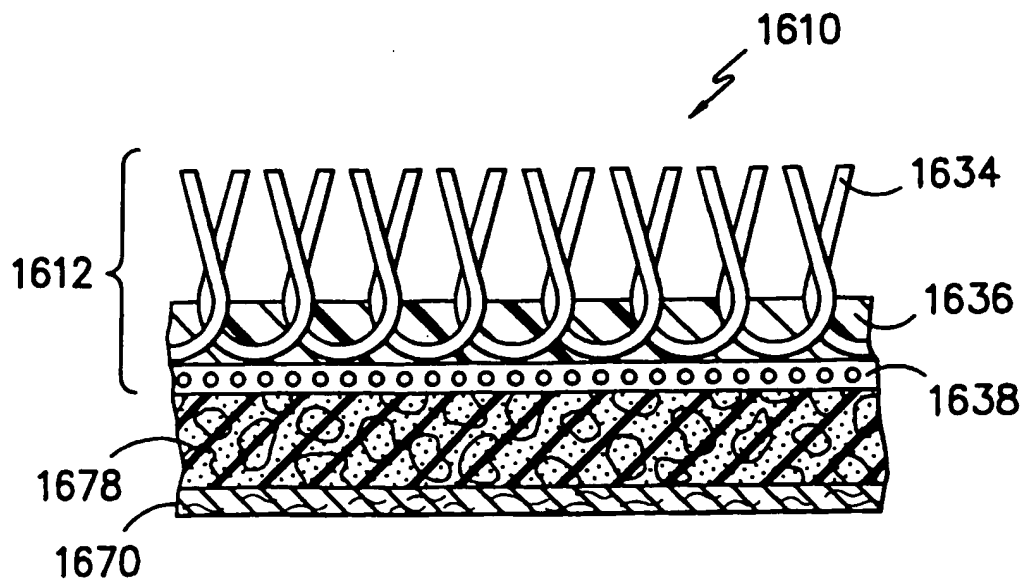
*FIG. -15A-*



*FIG. -15B-*



*FIG. -16A-*



*FIG. -16B-*

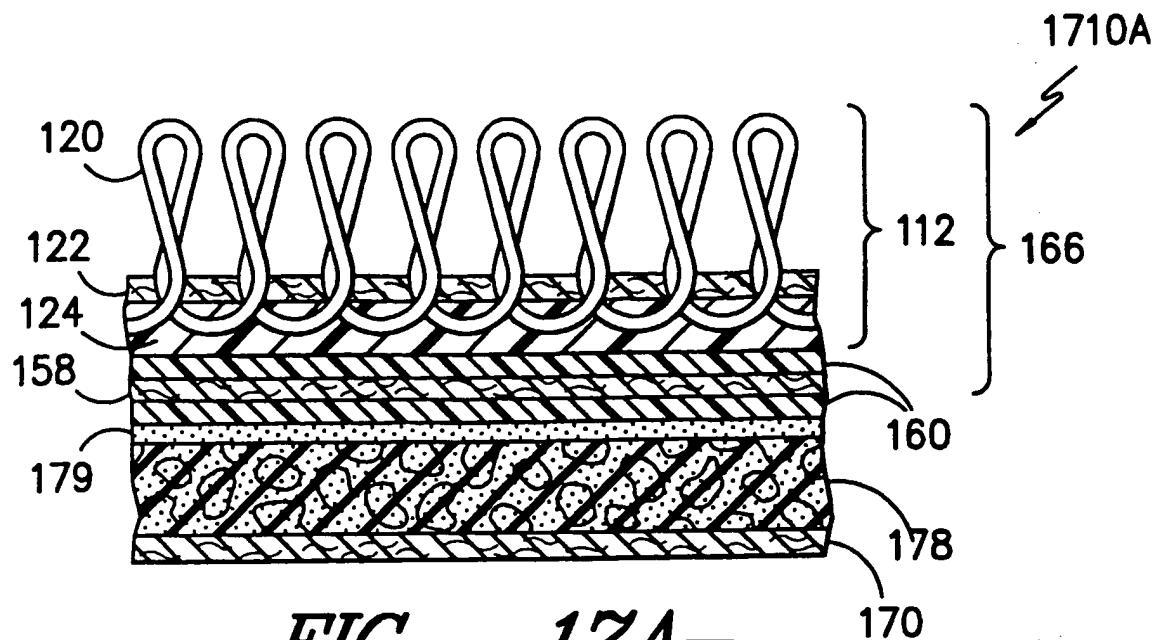


FIG. -17A-

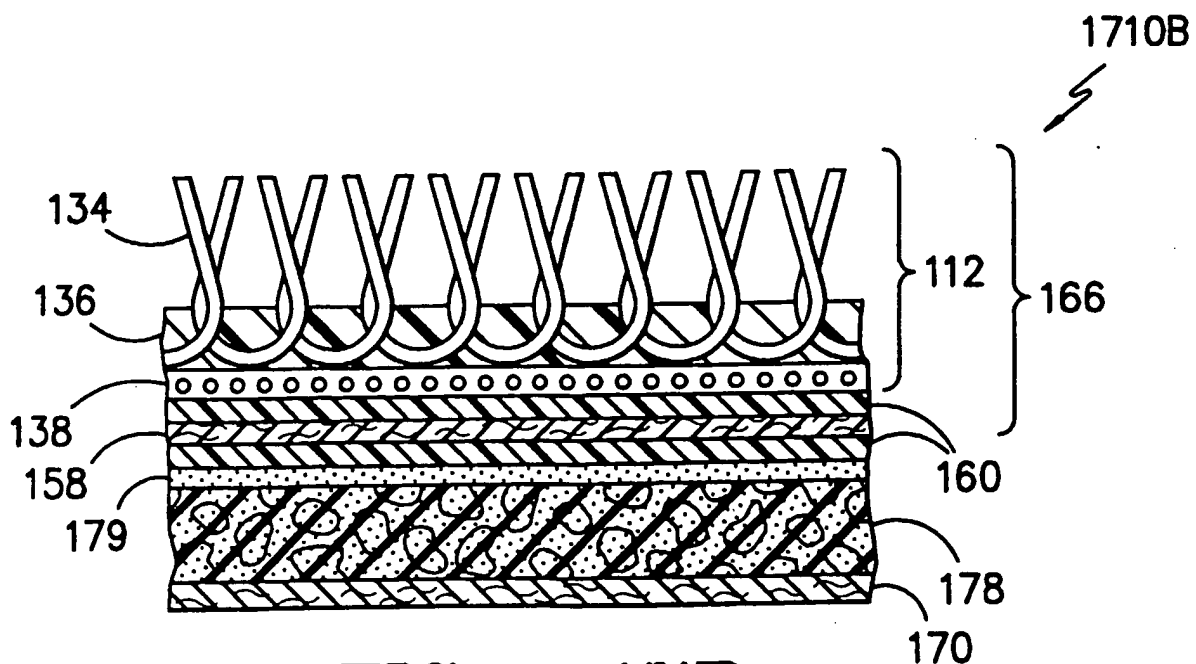
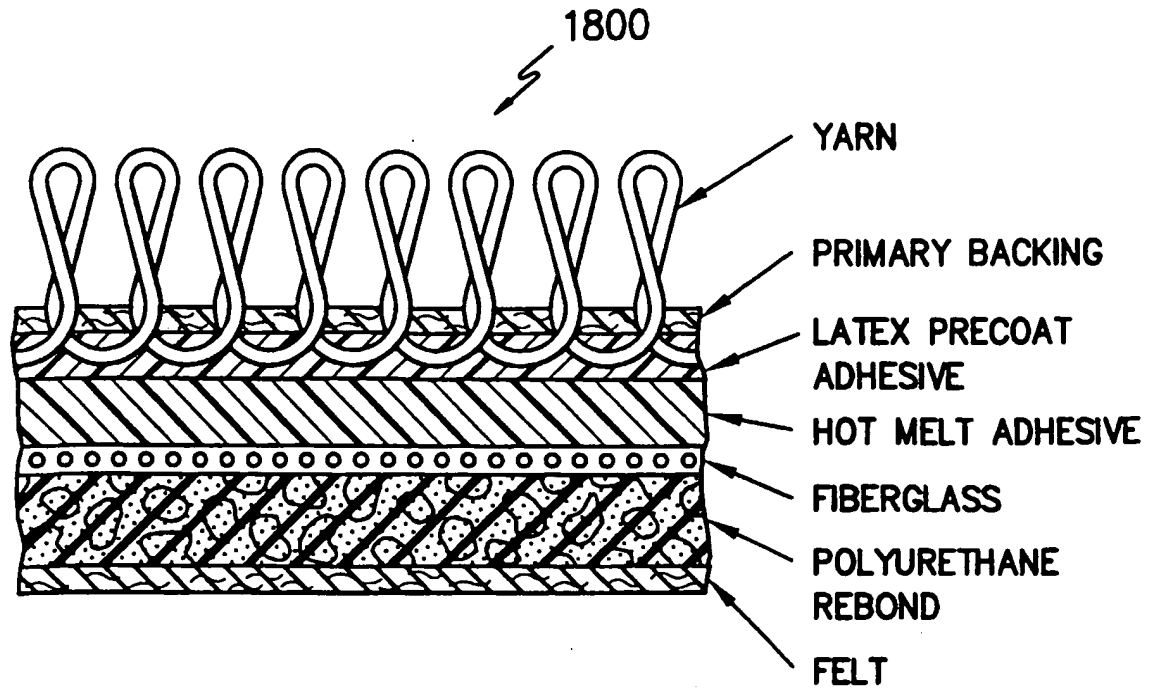
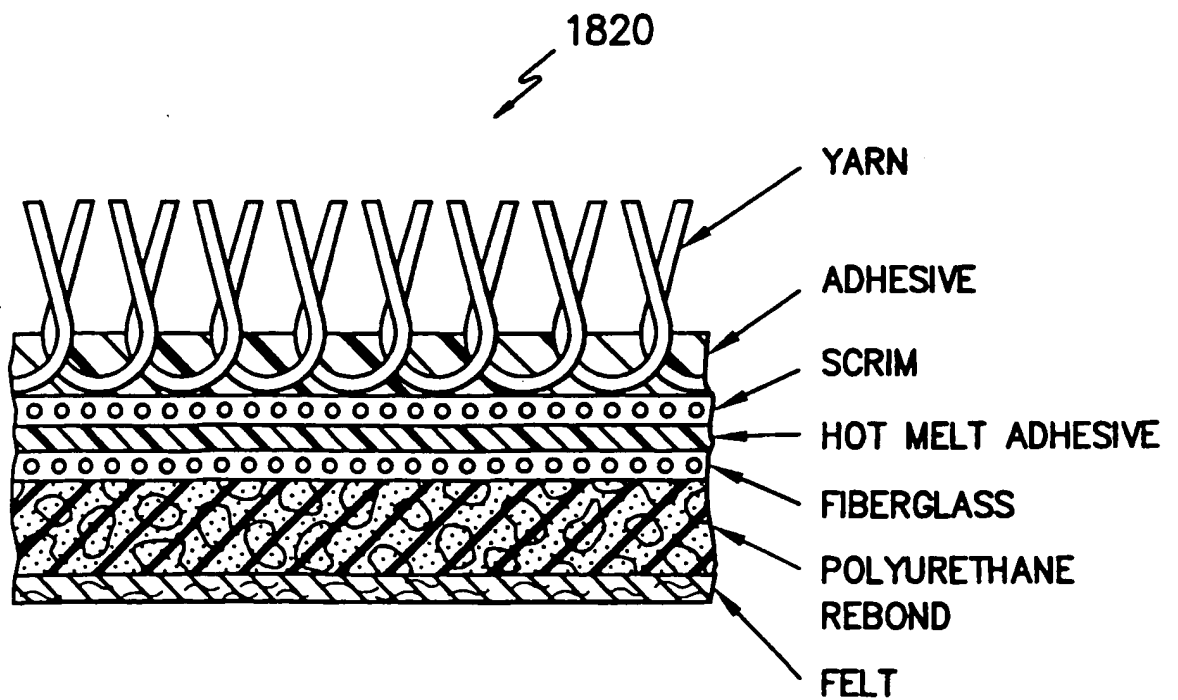


FIG. -17B-

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*FIG. -19A-*



*FIG -19B-*

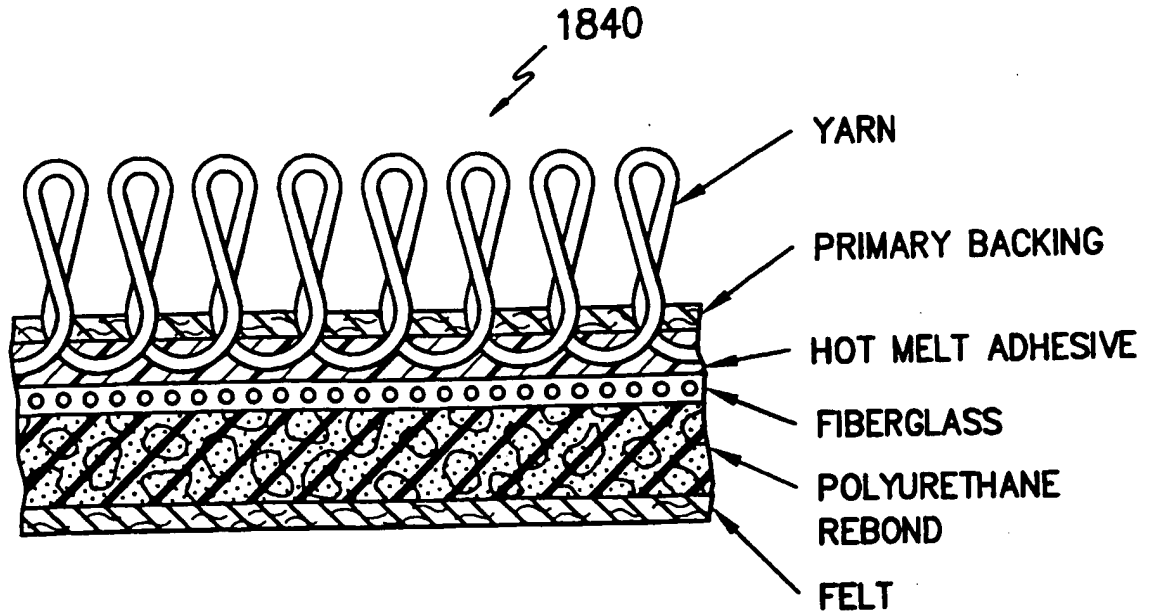


FIG. -20-

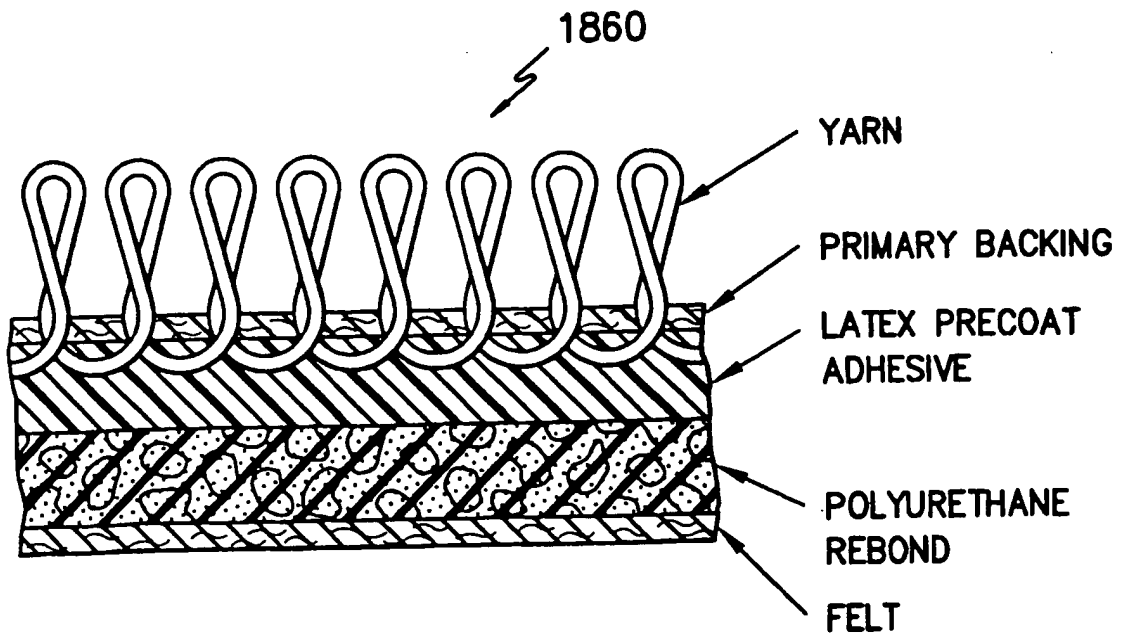
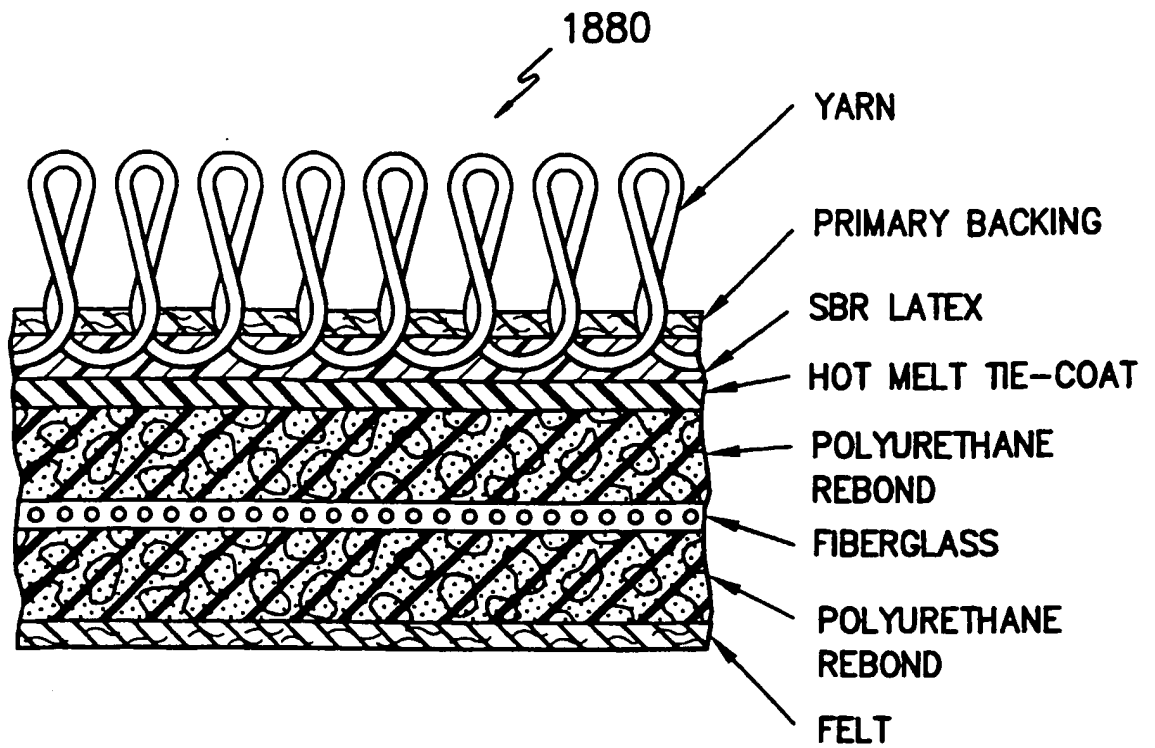
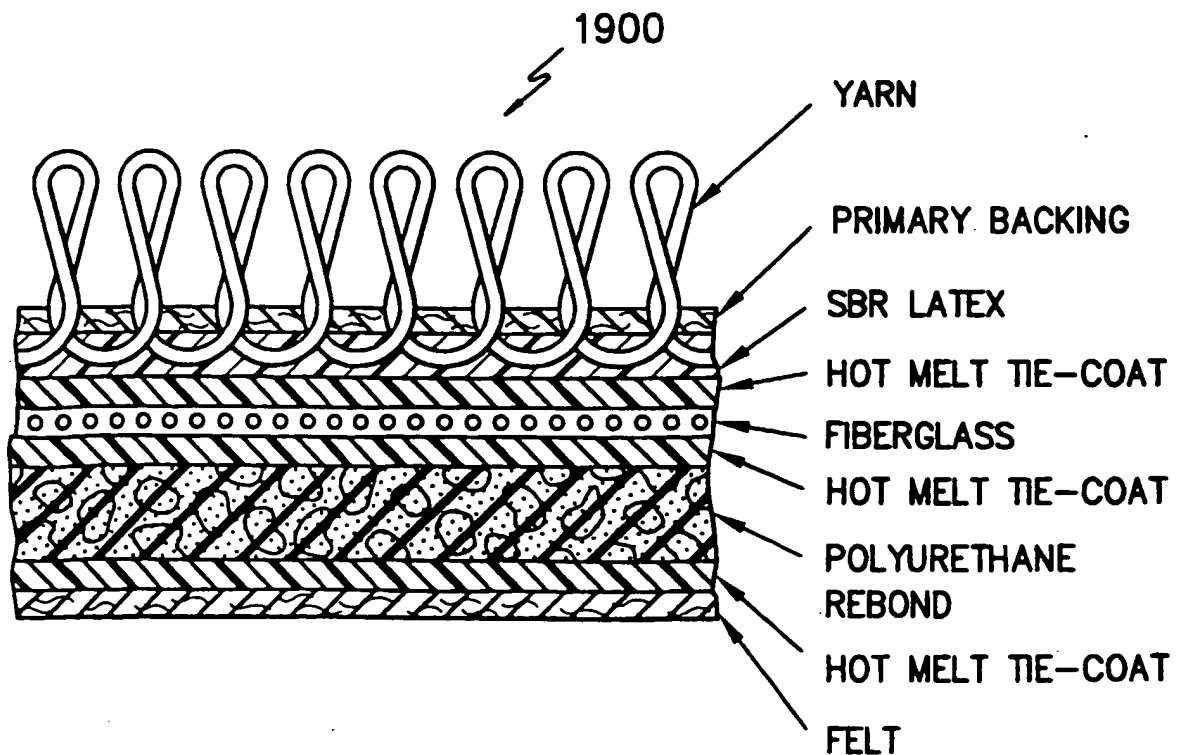


FIG -21-

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*FIG. -22-*



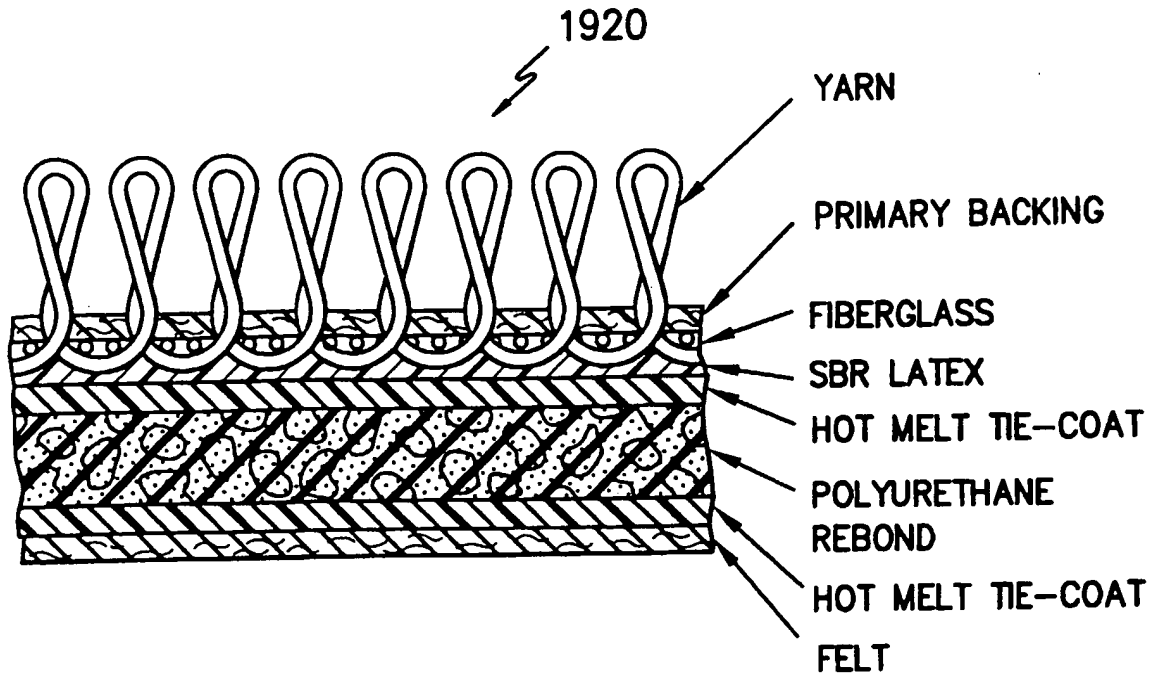


FIG. -24-

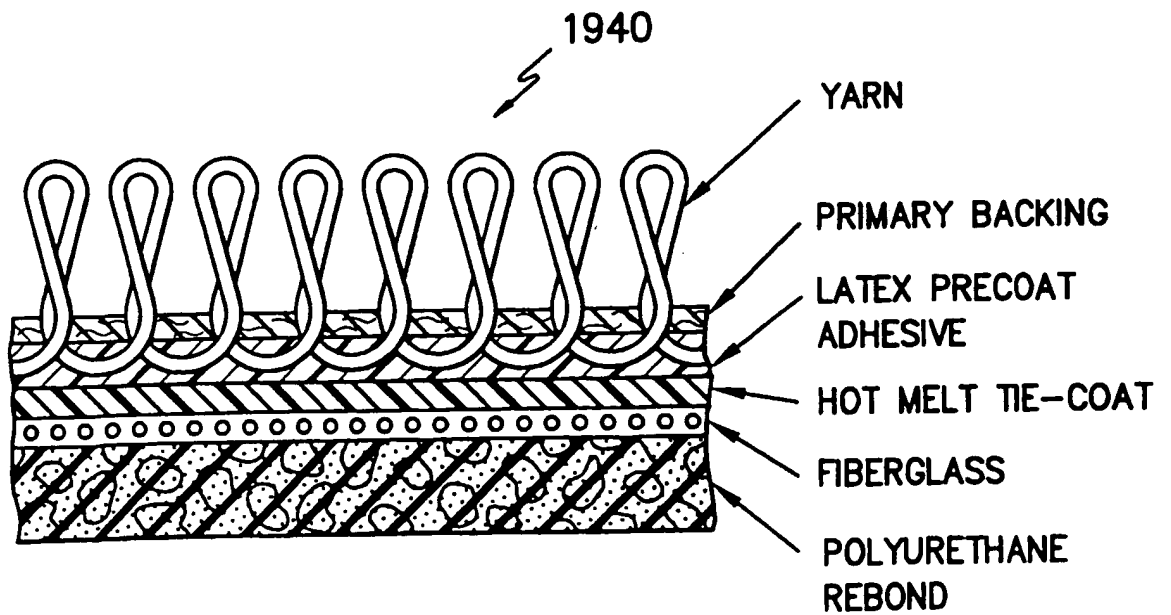
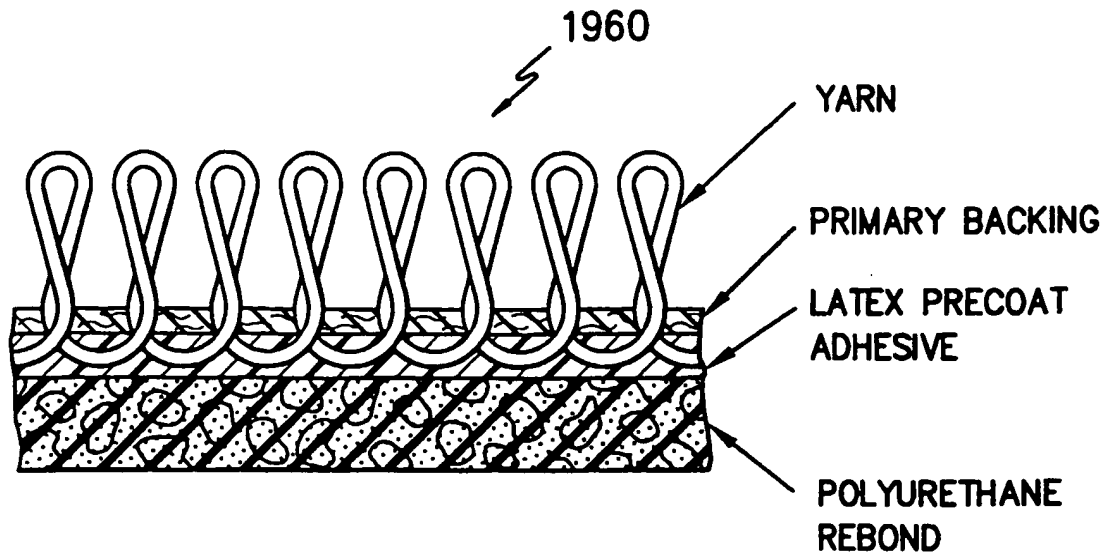
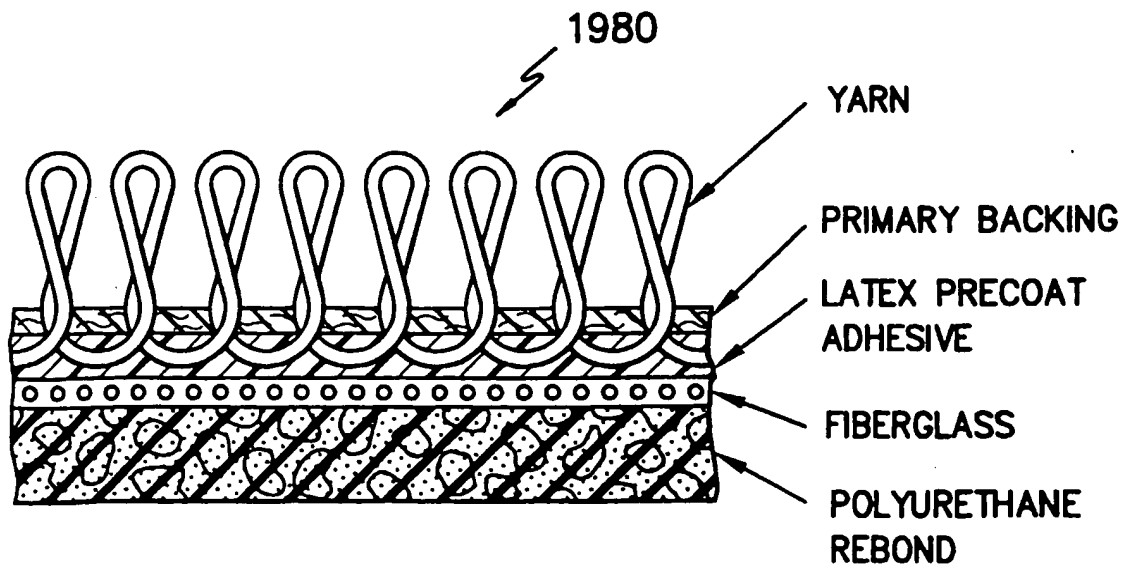


FIG. -25-

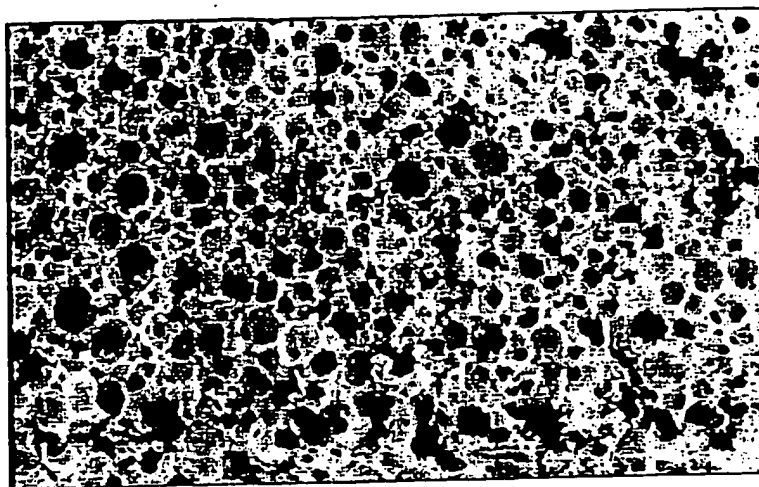


*FIG. -26-*

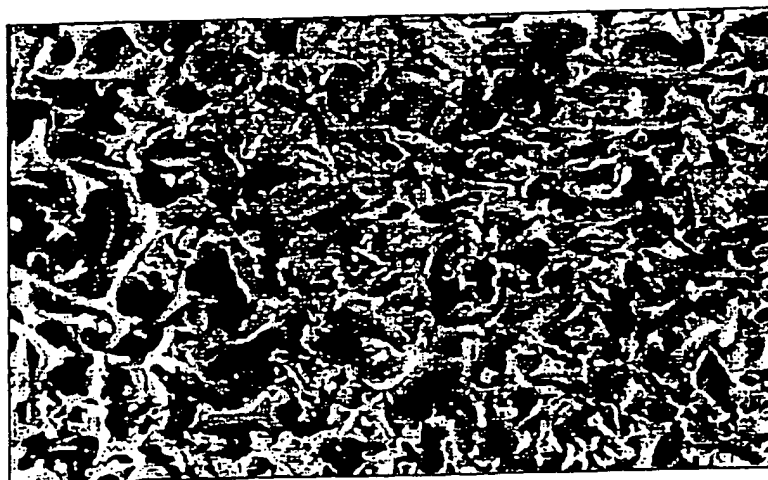


*FIG. -27-*

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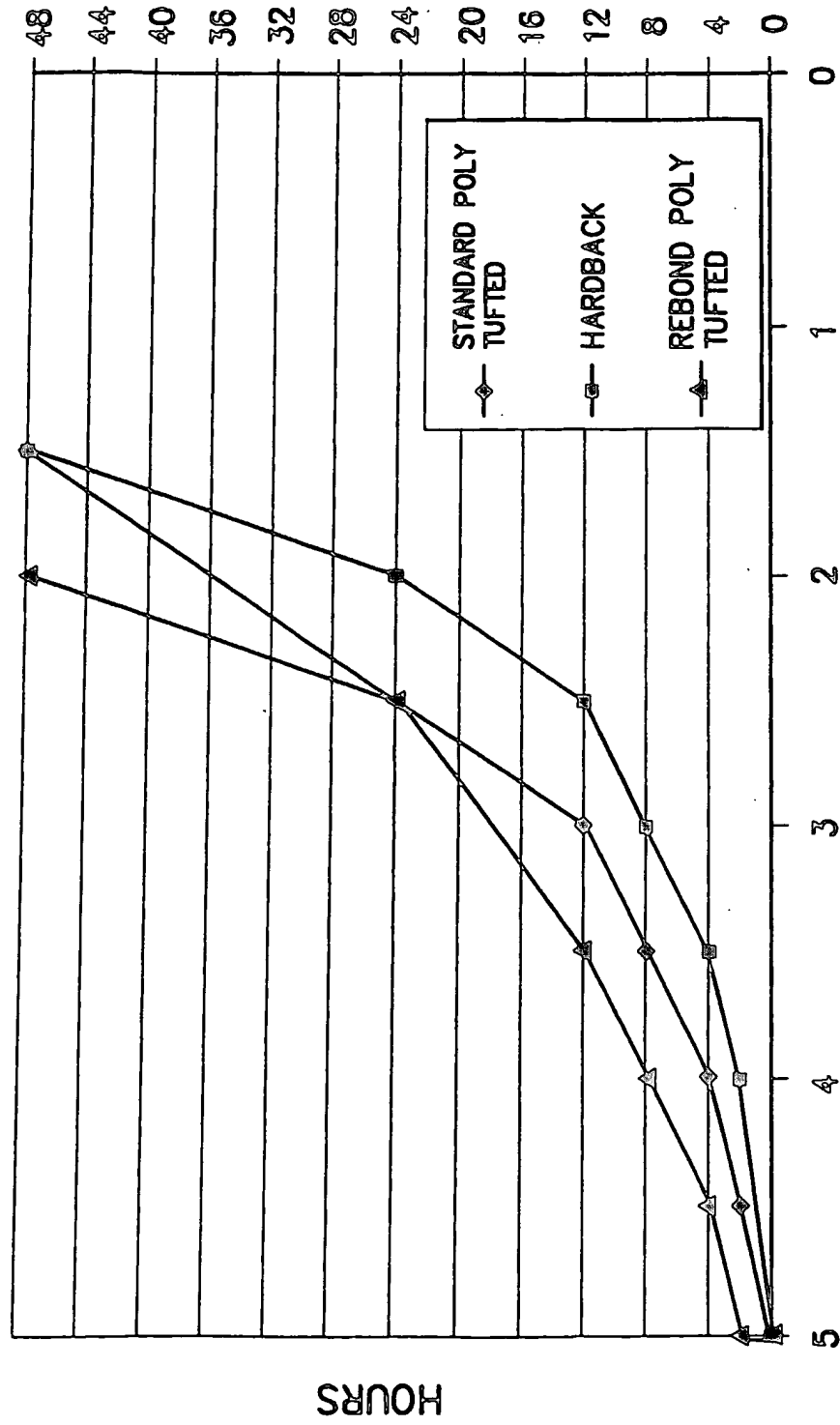
*FIG. -33-*



*FIG. -34-*

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# HEXAPOD COMPARISON TUFTED



RATING

FIG. -35-

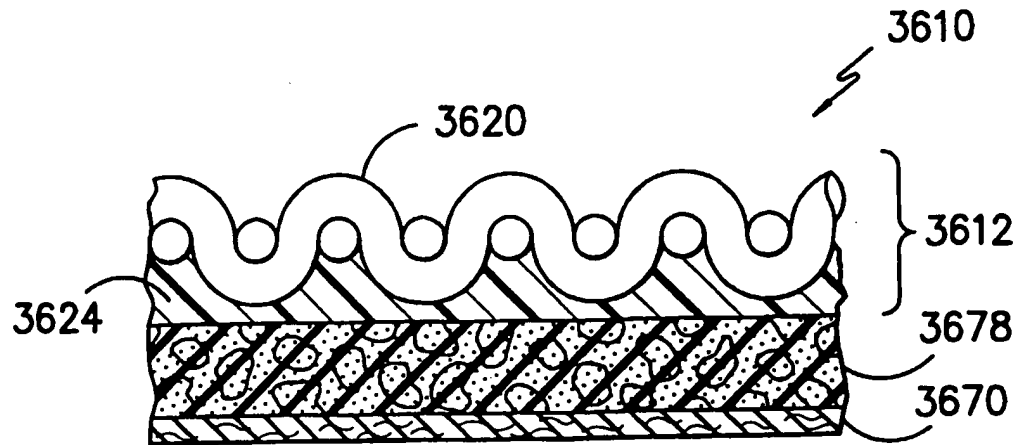


FIG. -36-

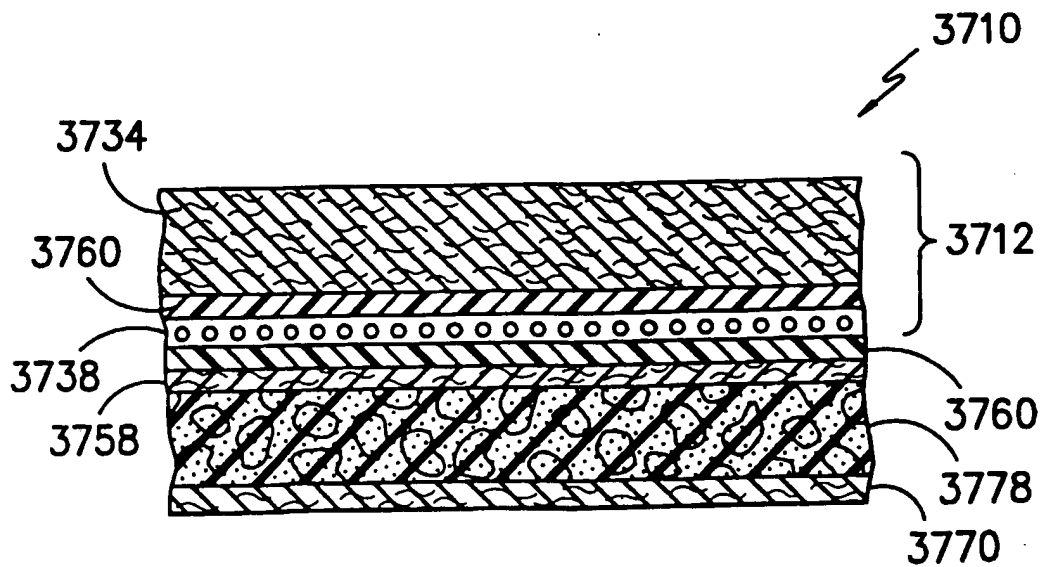
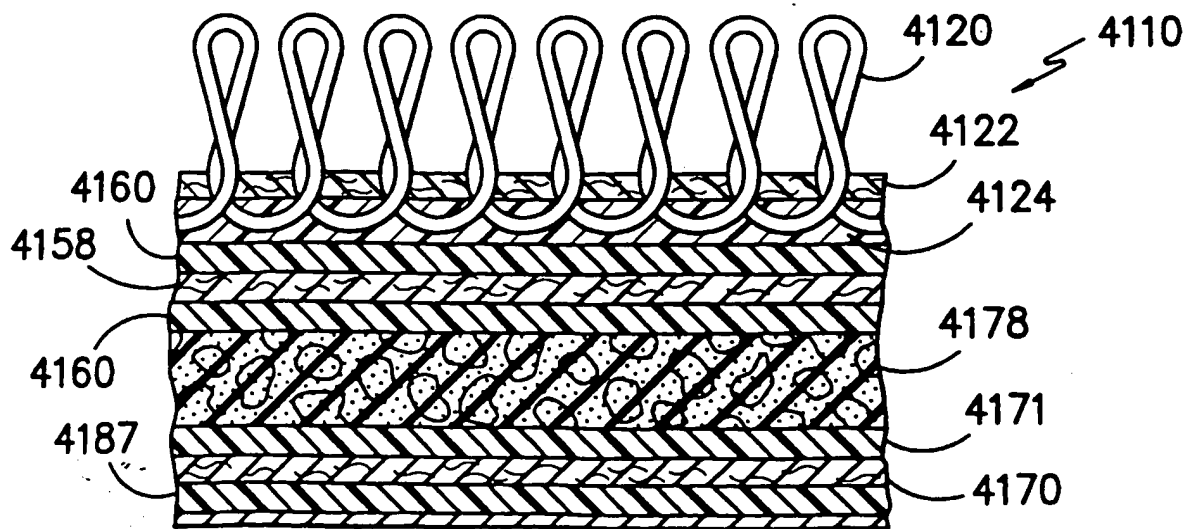
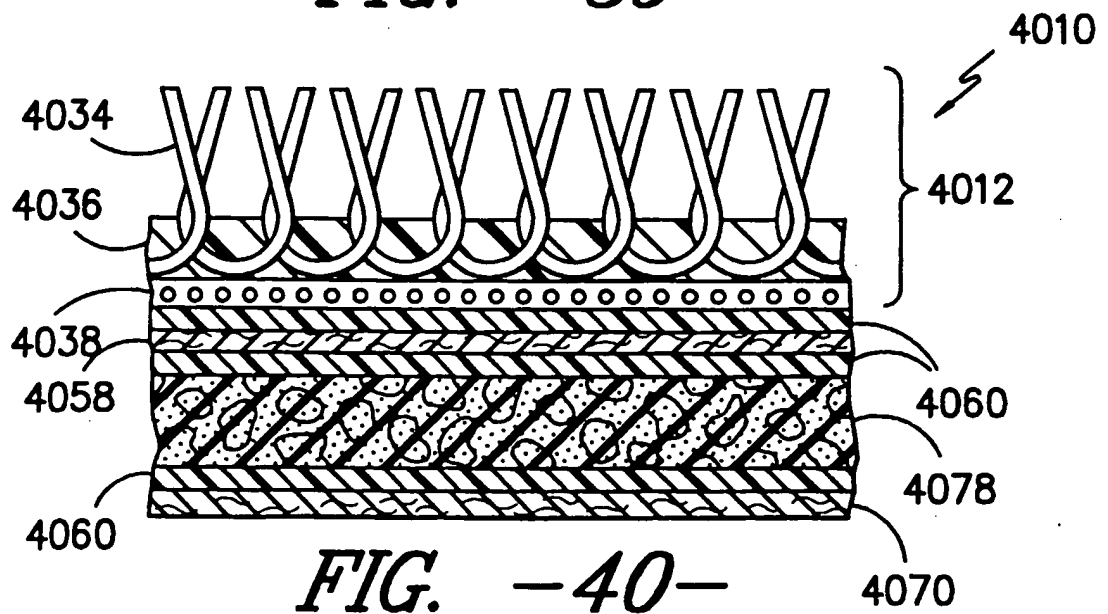
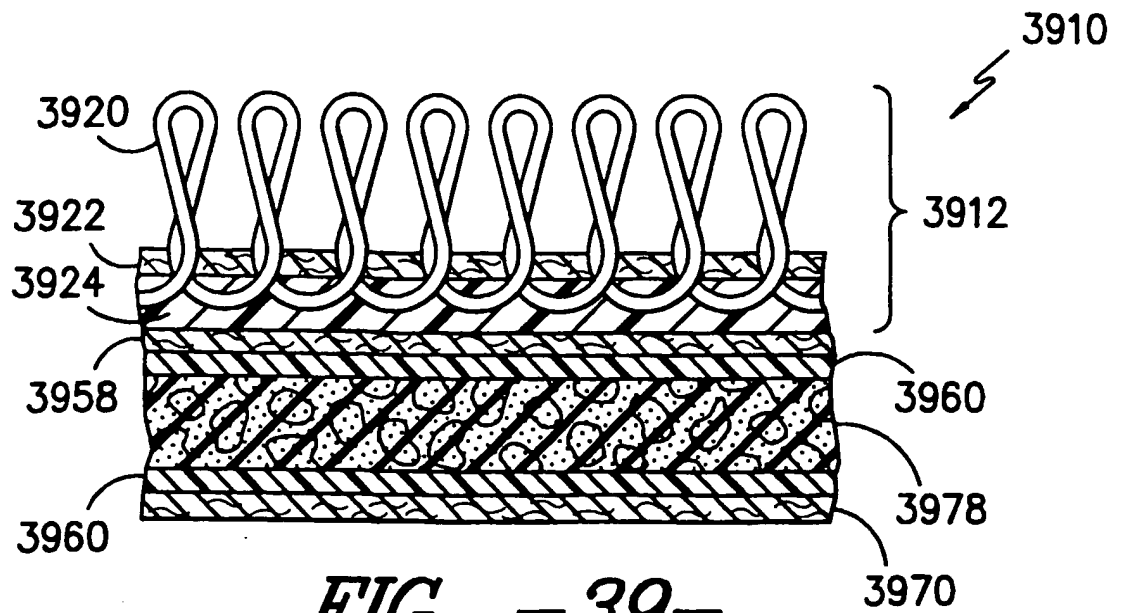


FIG. -37-





## CARPET TILE

### Technical Field

The present invention relates to carpet tiles, particularly to cushion backed carpet tiles and carpet tiles incorporating recycled materials.

### 5 Background to the Invention

U. S. Patent Nos. 4,522,857, 5,540,968, 5,545,276, 5,948,500, and 6,203,881 describe carpet or carpet tiles having cushioned backings. U. S. Patent No. 5,948,500 gives examples of both tufted and bonded carpet products. In the tufted carpet a primary carpet fabric is bonded to an adhesive layer in which is embedded a layer of glass scrim. A foam base composite is likewise adhesively  
10 bonded to the adhesive layer. In such tufted carpet construction, the primary carpet fabric includes a loop pile layer tufted through a primary backing such as a non-woven textile by a conventional tufting process and held in place by a pre-coat backing layer of latex or other appropriate adhesive. The foam base composite of the tufted carpet product includes an intermediate layer moulded to a layer of urethane foam.

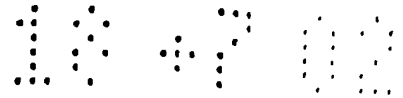
15 The bonded carpet product of U.S. Patent No. 5,948,500 employs the same type of foam base composite adhesively bonded by adhesive laminate layers in which is disposed a layer of glass scrim. However, the primary bonded carpet fabric has somewhat different components from that of the tufted product in that it has cut pile yarns implanted in an adhesive such as PVC, latex, or hot melt adhesive and has a woven or non-woven reinforcement or substrate layer of material  
20 such as fibreglass, nylon, polypropylene, or polyester.

The formation of a foam base composite for use in prior cushioned carpeting constructions of either tufted or bonded configuration has typically involved pre-forming and curing virgin urethane foam across a carrier or backing material by practices such as are disclosed in U.S. Patent Nos. 4,171,395, 4,132,817, and 4,512,831. As described in these patents, such a foam base  
25 composite may be laminated to a carpet base thereby yielding a cushioned structure.

A cushion backed carpet tile sold under the trademark Comfort Plus by Milliken & Company of LaGrange, Georgia has a primary carpet fabric with a face weight of about 20 to 40 oz/yd<sup>2</sup> (679 to 1358 g/m<sup>2</sup>), a hot melt layer of about 38 to 54 oz/yd<sup>2</sup> (1290 to 1833 g/m<sup>2</sup>), a polyurethane cushion of about 0.10 to 0.2 inches (2.5 to 5.1 mm) thick, a cushion weight of about 20-34 oz/yd<sup>2</sup> (951-  
30 1154 g/m<sup>2</sup>), a cushion density of about 18 lbs. per cubic foot (289 kg/m<sup>3</sup>), and an overall product height of about 0.4 - 0.8 inches (10.1 - 20.3 mm).

### Disclosure of Invention

According to the present invention there is provided a carpet tile comprising a carpet and a cushion comprising compressible particles bonded together with a binder, the cushion being



attached to and below the carpet. This carpet tile provides advantages over previous cushion back carpet tiles by providing a relatively low cost, environmentally friendly, aesthetically pleasing, stable, and/or durable product. Preferably the cushion is a foam cushion.

5 The binder quantity is about 25% or less by weight, preferably 15% or less by weight and most preferably 10% or less by weight.

The foam cushion preferably incorporates a layer of foam comprising compressible particles bonded together, such as rebond foam as hereinafter defined or another compressed particle foam. The textile or carpet construction of the present invention is suitable for manufacture by a wide variety of techniques including lamination of a preformed pre-cured layer of foam material, lamination of a preformed carpet and a preformed foam layer, or by an in-line application process.

The carpet is conveniently selected from one or more of tufted, bonded, flocked, needle punched, and woven carpet. The carpet may have a face weight of about 20 - 60 oz/yd<sup>2</sup> (679 - 2037 g/m<sup>2</sup>) or about 12 - 20 oz/yd<sup>2</sup> (407 - 679 g/m<sup>2</sup>). Advantageously the carpet has a face weight of less than or equal to about 55 (1867 g/m<sup>2</sup>), preferably 45 oz/yd<sup>2</sup> (1528 g/m<sup>2</sup>).

15 In one embodiment of the present invention, a modular carpet composite which may be cut to form modular carpet tiles includes a carpet or greige carpet having, for example, a face weight of less than or equal to about 45 oz/yd<sup>2</sup> (1528 g/m<sup>2</sup>), a hot melt layer of about 70 oz/yd<sup>2</sup> (2376 g/m<sup>2</sup>), and a cushion of about 0.04 - 0.50 inches (1 - 12.7 mm) thick. The cushion may have a density of about 20 lbs. per cubic foot (321 kg/m<sup>3</sup>) or less.

20 At least one layer of adhesive material may be provided between said carpet and said foam cushion. A layer of reinforcing material may advantageously be disposed within the layer of adhesive material such that at least a portion of the layer of adhesive material extends away from at least one side of the layer of reinforcing material. Use of a reinforcing material provides great stability to the carpet tile.

25 The adhesive material preferably comprises at least one of a thermoplastic and thermoset adhesive, wherein the adhesive is present at a level of less than or equal to about 100 oz/yd<sup>2</sup> (3395 g/m<sup>2</sup>), preferably about 35 - 90 oz/yd<sup>2</sup> (1188 - 3055 g/m<sup>2</sup>). Desirably the adhesive material comprises a hot melt adhesive which is present at a level of about 36 - 60 oz/yd<sup>2</sup> (1222 - 2037 g/m<sup>2</sup>) and sometimes 36 - 50 oz/yd<sup>2</sup> (1222 - 1697 g/m<sup>2</sup>). Alternatively, or additionally, the adhesive material may comprise a polyolefin based thermoplastic hot melt adhesive or a polyurethane thermoset adhesive.

35 Most advantageously the foam cushion comprises polyurethane rebond. Preferred grades of rebond have a density of about 2 to 20 lbs. per cubic foot (32 to 321 kg/m<sup>3</sup>), preferably 2 to 12 lbs. per cubic foot (32 to 193 kg/m<sup>3</sup>), more preferably 6 to 12 lbs. per cubic foot (96 - 193 kg/m<sup>3</sup>) and most preferably 8 to 12 lbs. per cubic foot (128 - 193 kg/m<sup>3</sup>). Furthermore the rebond giving the best performance is characterized by an uncompressed chip particle size of about 25 mm or



less, preferably 15 mm or less most preferably 10 mm or less and even more preferably in the range 4 to 10 mm. The rebond foam cushion is further characterised by a thickness of 2 to 20 mm, preferably 2 to 7 mm and most preferably about 4 mm.

5 When the foam cushion comprises rebond it is particularly advantageous for the layer of adhesive material substantially to permeate and cover the layer of reinforcing material and to extend in bonding relation between said carpet and said rebond foam cushion such that said carpet and said rebond foam cushion are adhesively bonded to one another by said mass of adhesive material.

10 When the carpet is a tufted or bonded carpet it is preferable for the layer of adhesive material to extend between said rebond foam cushion and the underside of said carpet.

The carpet tile may comprise a carpet which is formed of carpet fabric having a pile side and a base with a plurality of pile forming yarns projecting outwardly from the pile side, a rebond foam cushion layer disposed at a position below the carpet; and a bridging composite extending in bonding relation substantially between the base and an upper side of the rebond foam cushion layer wherein the bridging composite consists essentially of a layer of stabilising material having a first side and a second side, a first layer of at least one resilient adhesive extending away from the first side of the stabilising material into contacting relation with the base and a second layer of at least one resilient adhesive extending away from the second side of the layer of stabilising material into contacting relation with the upper side of the rebond foam cushion layer such that the layer of stabilising material is bonded between the first and second layers of resilient adhesive at a position between the base and the rebond foam cushion layer.

25 When the carpet fabric is a tufted carpet the base comprises a backing and a layer of adhesive pre-coat extending across the underside of the backing. The pre-coat may comprise at least one of a latex and hot melt adhesive. The combined mass of the first layer of at least one resilient adhesive and the second layer of at least one resilient adhesive is preferably not greater than about 100 oz/yd<sup>2</sup> (3395 g/m<sup>2</sup>).

30 The first and second layers of adhesive are preferably the same type of adhesive and the cushion thickness is between 0.04 and 0.5 inches (1 and 12.7 mm), preferably between 0.08 and 0.18 inches (2 and 4.6 mm). Desirably for a lightweight carpet tile the cushion weight is less than 26 oz/yd<sup>2</sup> (883 g/m<sup>2</sup>).

Carpet tiles according to the invention have some important performance characteristics. For example the foam cushion has an internal tear strength of at least 3 lbs (13.3 N). In the case where the foam cushion is a compressed particle foam it should have a compressibility of less than 100% of the foam thickness at 40 psi (2.7 bar).

Conveniently the foam cushion is at least one of a cut, slit and peeled foam and to give the best environmental profile the foam cushion should have a recycled content of at least 80% and preferably at least 85%.

5 For good performance when laid on damp floors such as recently cast concrete the foam cushion should comprise an open celled foam comprised of open celled foam particles bonded together. Preferably the open celled foam is comprised of foamed polyurethane. Most preferably the foam cushion is substantially free of any filler.

10 The binder for the foam cushion may contain at least one additive selected from flame retardant, anti-bacterial, colour, anti-microbial, anti-fungal, conductive, anti-static, fibres, magnetic or metallic particles and combinations thereof.

Preferably the carpet tile has an overall height of less than 12 mm.

15 The invention further includes a cushion back module for a carpet tile comprising: a slit rebond layer, a reinforcing layer bonded to the top surface of the rebond layer and a backing layer bonded to the bottom surface of the rebond layer. The backing layer is preferably a non-woven backing but it could also be a film layer such as paper or plastics film or it may be a woven material.

20 The modular carpet composite or modular carpet tile incorporating compressed particle foam or rebond foam preferably having recycled content has unexpectedly excellent look, wear, cushion, resilience, under foot comfort, and performance characteristics that rate it for heavy commercial use. Hence, such a carpet composite or carpet tile may be used in place of standard cushion backed or hard backed carpet tile, or broadloom carpet thus reducing cost, reducing material requirements, reducing weight, reducing energy requirements, and reducing environmental impact.

25 It has been discovered that a carpet composite or carpet tile having excellent look, feel, wear, resilience, and underfoot comfort and exhibiting performance characteristics that rate it for heavy commercial use can be formed by combining a carpet with a hot melt or resilient layer and a rebond foam cushion.

In accordance with one embodiment of the present invention, a low weight modular carpet tile is provided having an overall height of about 0.10 to 0.75 inches (2.5 to 19 mm) thick, preferably 0.20 to 0.50 inches (5.1 to 12.7 mm) thick, depending on the construction of the carpet tile (the number of layers or components) and which may be cut to form any shape.

30 The rebond foam layer may be disposed adjacent to a non-woven backing layer.

The carpet tile may include a carpet having a base and a plurality of pile-forming yarns projecting outwardly from one side. A cushion layer is bonded to the base on the side away from the pile-forming yarns. The cushion layer may be bonded directly to the base or alternatively it may be bonded through a layer of reinforcement material which is bonded to the base on the side away

from the pile-forming yarns. The reinforcement material is adjacent to, and preferably attached to, a foam or cushion layer such as rebound foam. An optional backing material is preferably disposed on the underside of the cushion layer. The backing material may include an adhesive backing on the side away from the cushion layer.

- 5 An alternative or additional layer of reinforcement material may be embedded in the cushion layer. The cushion layer may be bonded to the carpet by a layer of adhesive such as hot melt.

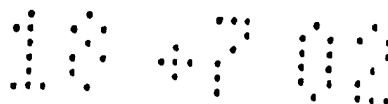
The carpet tile may comprise a reinforcement layer which is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a carpet and above a foam or cushion layer such that at least a portion of the polymeric adhesive is disposed on and extends away from either  
10 side of the reinforcement layer.

The reinforcement layer may be disposed intermediate discrete or intermixed layers of adhesive below a carpet and adjacent the upper surface of a foam layer such that the adhesive bonds the carpet to the foam layer with the reinforcement layer disposed at an intermediate position between  
15 the carpet and the foam layer. The layer of reinforcing material comprises at least one of a porous scrim, woven, and non-woven material. Desirably the reinforcement material is formed of fibreglass. The reinforcement material may comprise a porous textile structure and may consist essentially of polyester. The reinforcing material may alternatively comprise a plurality of glass  
20 fibres or a plurality of polyester fibres. At least a portion of the material forming the adhesive is desirably disposed on at least one side of the reinforcement layer. The adhesive is preferably polymeric adhesive and is most preferably a resilient polymeric adhesive. The carpet tile preferably includes a layer of thermoplastic or thermoset adhesive. The reinforcement layer may alternatively be a stabilising layer.

The cushioned carpet tile may have reinforcement or stabilising layer disposed above a rebound foam cushion layer.

25 The cushioned carpet tile may have a reinforcement layer of non-woven glass disposed between layers of a hot melt polymeric adhesive below a carpet and above a rebound foam layer such that the hot melt polymeric adhesive extends in joining relation between the carpet and one side of the rebound foam layer with the reinforcement layer being held within the hot melt polymeric adhesive at a position between the rebound foam layer and the carpet such that at least a portion of the hot  
30 melt polymeric adhesive extends away from either side of the reinforcement layer. An optional backing material or multi-component backing composite may be disposed on the underside of the rebound foam layer.

The carpet tile may be manufactured by joining together the carpet and a module formed from rebound. The module has a non-woven cloth flame laminated to the surface which forms the base  
35 of the carpet tile and a reinforcement layer flame laminated to the surface which will then be bonded to the carpet.



The invention will now be further described by way of example only and with reference to the accompanying drawings of which:

5 FIG. 3A is a cut-away side view of a carpet tile construction according to an embodiment of the present invention incorporating a loop pile tufted carpet surface;

FIG. 3B is a cut-away side view of a carpet tile construction according to another embodiment of the present invention incorporating a cut loop tufted carpet surface;

FIG. 3C is a cut-away side view of a carpet tile construction according to still another embodiment of the present invention incorporating a bonded carpet surface;

10 FIG. 6A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction having no separate adhesive pre-coat;

FIG. 6B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction having no separate adhesive pre-coat;

15 FIG. 7A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction having a reinforcement layer disposed between two different adhesive layers;

FIG. 7B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction having a reinforcement layer disposed between two different adhesive layers;

FIG. 7C is a cut-away side view of an alternative embodiment of a bonded carpet tile construction having a reinforcement layer disposed between two different adhesive layers;

20 FIG. 8A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction having a reinforcement layer disposed between two layers of latex adhesive;

FIG. 8B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction having a reinforcement layer disposed between two layers of latex adhesive;

25 FIG. 9A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction having glass reinforcement disposed across the underside of the backing;

FIG. 9B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction having glass reinforcement disposed across the underside of the backing;

FIG. 10A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction including a multi-component backing composite;

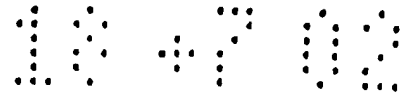


FIG. 10B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction including a multi-component backing composite;

FIG. 10C is a cut-away side view of an alternative embodiment of a bonded carpet tile construction including a multi-component backing composite;

- 5 FIG. 11A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction including a foam cushion with no backing;

FIG. 11B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction including a foam cushion with no backing;

- 10 FIG. 11C is a cut-away side view of an alternative embodiment of a bonded carpet tile construction including a foam cushion with no backing;

FIG. 12A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction including a foam cushion with a releasable adhesive backing;

FIG. 12B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction including a foam cushion with a releasable adhesive backing;

- 15 FIG. 12C is a cut-away side view of an alternative embodiment of a bonded carpet tile construction including a foam cushion with a releasable adhesive backing;

FIG. 13A is a cut-away side view of an alternative embodiment of a loop pile tufted carpet tile construction including a multi-component composite backing including a releasable adhesive underside;

- 20 FIG. 13B is a cut-away side view of an alternative embodiment of a cut pile tufted carpet tile construction including a multi-component composite backing including a releasable adhesive underside;

FIG. 13C is a cut-away side view of an alternative embodiment of a bonded carpet tile construction including a multi-component composite backing including a releasable adhesive underside;

- 25 FIG. 14A is a cut-away view of another embodiment of a tufted carpet tile construction with a cushioned composite structure.

FIG. 14B is a cut-away side view of another embodiment of a bonded carpet tile construction incorporating a cushioned composite structure;

FIG. 15A is a cut-away side view of still another embodiment of a tufted carpet tile construction;

- 30 FIG. 15B is a cut-away side view of still another embodiment of a bonded carpet tile construction;

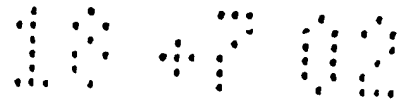


FIG. 16A is a cut-away side view of an alternative embodiment of a tufted carpet tile construction having no reinforcement layer;

FIG. 16B is a cut-away side view of an alternative embodiment of a bonded carpet tile construction having no reinforcement layer;

5 FIG. 17A is a cut-away side view of an alternative structure for a tufted carpet tile;

FIG. 17B is a cut-away side view of an alternative structure for a bonded carpet tile;

10 Figures 19 – 27 are cut-away side view construction or layer diagrams of respective tufted and bonded carpet tiles in accordance with different embodiments, examples, or aspects of the present invention, although Figures 19A and 20-27 show a tufted looped pile in the carpet and Figure 19B shows a bonded cut pile carpet, it is to be understood that a tufted or bonded looped and/or cut pile may be used and that the pile may be sculptured, printed, dyed, and/or the like as desired;

FIG. 33 is a micrograph illustration of the cross-section of a conventional polyurethane foam cushion material;

15 FIG. 34 is a micrograph illustration of the cross-section of a small chip size, polyurethane rebond foam material in accordance with at least one embodiment of the present invention;

FIG. 35 is a graphical representation of the Hexapod rating comparison of several products;

Figures 36 and 37 are cut-away side views of respective alternative embodiments of woven and non-woven carpet tile constructions;

20 FIGS. 39, 40 and 41 are cut-away side views of respective tufted and bonded carpet tile constructions in accordance with other selected embodiments of the present invention.

Referring to FIGS 3A, 3B and 3C of the drawings, the basic components of the carpet tile construction according to the present invention are indicated. The tufted and bonded carpet constructions 110A, 110B, 110C of the present invention incorporate a layered arrangement of a pile forming carpet fabric 112 in overlying relation to a sheet of reinforcement material 158, which in turn is disposed in overlying relation to a layer of cushioning or foam 178, such as rebond foam or compressed particle foam which may include an optional backing layer 170 (FIGS. 3A, 3B, 3C) or multi-component backing composite (FIGS. 10A-C and 13A-C) as will be described further hereinafter. The optional backing layer 170 is preferably a woven or non-woven textile fabric of polyester, polypropylene, polyester/polypropylene, polyester/polypropylene/acrylic, or other appropriate fibres or blends and may contain a colorant, binder, or the like. A non-woven structure of about 80% polyester fibre and about 20% polypropylene fibre, about 50% polyester fibre and

about 50% polypropylene fibre, or about 100% polyester fibre may be particularly preferred depending on the face construction of the composite.

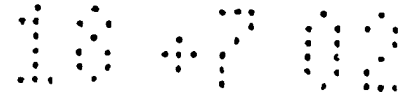
Also, a blend of 50% polyester fibre, 20% polypropylene, and 30% acrylic fibres may be used. The polyester, polypropylene and/or acrylic fibres may be of one or more selected colours to give the backing a desired colour or appearance. In one embodiment, the foam and backing have a similar colour. In a particular example, the foam and/or backing have a green, blue, purple, or gold colour. The colour of the backing can be achieved, for example, by using a white polyester fibre and a coloured acrylic fibre or by using coloured polyester and/or polypropylene fibres.

The sheet of reinforcement material 158 is preferably embedded between layers of adhesive 160 such as a thermoplastic adhesive or thermoset adhesive, preferably a hot melt adhesive or the like extending on either side of the sheet of reinforcement material 158 to establish a bonding relationship between the carpet fabric 112 and the rebond cushioning or foam 178. Such layers of adhesive 160 may be either substantially discrete with the reinforcement material 158 establishing a barrier between such layers or the layers of adhesive 160 may be at least partially intermixed across the reinforcement material 158. In either event, due to the intimate bonding relationship between the reinforcement material 158 and the layers of adhesive 160, the layers of adhesive 160 in combination with the reinforcement material 158 forms a bridging composite of substantial stability extending between the cushioning foam or rebond foam 178 and the carpet fabric 112.

It is contemplated that the carpet fabric 112 may incorporate either a tufted or a bonded configuration (with loop and/or cut pile) as described in relation to FIGS. 3A, 3B, and 3C. It is also contemplated that the carpet 112 may take on any number of other pile forming or non-pile forming constructions including by way of example only and not limitation, flat or textured fabrics having woven, knit, or non-woven constructions (Figures 36 – 37).

According to one potentially preferred embodiment, the carpet fabric 112 preferably includes a plurality of pile-forming yarns projecting outwardly from one side of a base. It is contemplated that the carpet may include one or more backing or base layers.

It is to be understood that as the tufted or bonded carpet fabric 112 may have different embodiments, the component structure of the carpet fabric 112 is not critical to the present invention. Rather it is intended that any carpet fabric having a pile forming portion and a base or backing may be utilised as the carpet fabric. By "base" is meant any single layer or composite structure including, inter alia, the commonly used layered composite of backing and latex pre-coat for the cut pile construction and an adhesive layer with reinforcement substrate for a bonded construction. As will be appreciated, the use of polyester or a stabilised material in the base structure may be desirable due to the eventual heat curing such structure may undergo. Other embodiments as may occur to those of skill in the art may, of course, also be utilised. For



example, in the bonded product, the pile forming yarns can be heat tacked to the substrate as described in U. S. Patent No. 5,443,881 to permit simplified construction of a carpet.

Alternative embodiments including those disclosed in U.S. Pat. No. 4,576,665 may likewise be utilised. For example, it is contemplated that specialised backings such as non-woven structures comprising fibreglass sandwiched between layers of polyester may be utilised in the tufted carpet to impart the desired properties relating to stability thereby potentially reducing or even eliminating the need for the secondary backing or the latex pre-coat presently utilised in the manner to be described further hereinafter.

With regard to one embodiment, in the tufted carpet construction 110A of the present invention (FIG. 3A), the carpet fabric 112 preferably comprises a loop pile layer of pile-forming yarns 120 tufted into a backing 122 as is well known and held in place by a pre-coat layer 124 of a bonding material or adhesive such as latex, a hot melt adhesive or a urethane based adhesive.

With regard to another embodiment, in the cut pile tufted carpet construction 110B of the present invention (FIG. 3B), the carpet fabric 112 preferably comprises a loop pile layer of pile-forming yarns 120 tufted into a backing 122 as is well known and held in place by a pre-coat layer 124 of a bonding material such as latex, a hot melt adhesive or a urethane based adhesive. The pile forming yarns 120 are subjected to a tip shearing or loop cutting operation to yield the cut pile construction as shown.

For each embodiment described the two basic backing constructions are woven polypropylene and non-woven polyester. Each material may have a variety of construction characteristics engineered for a specific end use. According to one potentially preferred embodiment, the preferred backing material 122 is 20 pick per inch (7.9 pick per cm), woven polypropylene, with needle punched nylon fleece.

In the bonded carpet construction 110C of the present invention (FIG. 3C), the carpet fabric 112 preferably comprises a plurality of cut pile yarns 134 implanted in an adhesive 136 such as a latex or hot melt adhesive which is laminated to a reinforcement or substrate layer 138 of a woven or non-woven material including fibreglass, nylon, polyester or polypropylene. It is contemplated that this substrate layer 138 may be pre-coated with latex or other thermoplastic polymers to permit melting adhesion with the cut pile yarns 134 upon the application of heat, thereby potentially reducing or eliminating the need for the adhesive 136. It may be especially convenient if the adhesive layers 160 and 136 are the same material and are formed by all wing seepage through the substrate layer 138.

The yarns 120, 121, and 134 may be either spun or filament yarns and are preferably formed from a polyamide polymer such as nylon 6 staple, nylon 6 filament, nylon 6,6 staple, or nylon 6,6 filament available from companies like DuPont in Wilmington, Delaware or Solutia Fibers of St.



Louis, Missouri, although other suitable natural or synthetic yarns or blends may likewise be employed as will be recognized by those of skill in the art. By way of example only and not limitation, other materials, which might be used, include polyester staple or filament, polyethylene terephthalate (PET), and polybutylene terephthalate (PBT); polyolefins, such as polyethylene and polypropylene staple or filament; rayon; and polyvinyl polymers such as polyacrylonitrile. A variety of deniers, plies, twist levels, air entanglement, and heatset characteristics can be used to construct the yarn. Potentially preferred materials include nylon 6,6, filament, 1360 denier, 1 ply, no twist, no entanglement, and no heatset; nylon 6,6, staple, 3.15 cotton count, 2 ply, twisted, and heat set; nylon 6,6, mixed filament with a total yarn denier of about 1360; nylon 6,6, mixed filament with a total yarn denier of about 2400; and nylon 6,6, spun fibre with a cotton count of about 1.8 cc, and 2 ply. Wool yarn may also be used.

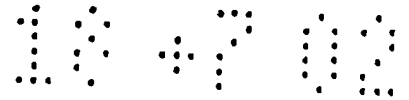
Although it is preferred that the yarn (or fibre) be a white or light colour to facilitate injection dyeing or printing thereof, it is to be understood that the yarn may be of any nature and colour such as solution dyed, naturally coloured, and the like, and be adapted for dye injection printing, screen printing, transfer printing, graphics tufting, weaving, knitting, or the like.

According to one embodiment, the face weight of the yarn across the carpet will be less than about 20 ounces per square yard ( $679 \text{ g/m}^2$ ) and will more preferably be not greater than about 15 ounces per square yard ( $509 \text{ g/m}^2$ ) and will most preferably be not greater than about 12 ounces per square yard ( $407 \text{ g/m}^2$ ). It is believed that the use of no twist yarn of sufficient denier (in the range of about 1000d to 1400d) in non-heatset form may facilitate the achievement of plush coverage even at such relatively low face weights due to bulking which takes place during subsequent dyeing and steaming operations.

According to another embodiment, the face weight of the yarns across the carpet will be in the range of about 20 to 60 ounces per square yard ( $679 - 2037 \text{ g/m}^2$ ) and will preferably be in the range of about 20 to 28 ounces per square yard ( $679 - 951 \text{ g/m}^2$ ).

In the tufted product, the adhesive pre-coat 124 is preferably styrene butadiene rubber (SBR) latex but other suitable materials such as styrene acrylate, polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), acrylic, and hot melt adhesives such as bitumen, polyurethane, polyester, polyamide, EVA, or based hot melt adhesives or blends thereof may likewise be utilised. As will be described further hereinafter, in the event that a hot melt adhesive is utilised, it is contemplated that a reinforcement material such as a fibreglass, nylon or polyester scrim woven or non-woven can be directly attached to form a composite laminate without the use of additional adhesive layers. Moreover, it is contemplated that the adhesive pre-coat 124 may be entirely eliminated in the tufted product if the loop pile 120 is tufted in suitably stable relation to the backing 122 thereby yielding a composite structure as illustrated in FIGS. 6A and 6B.

It is contemplated that a carpet construction according to the present invention including either a tufted or a bonded pile forming carpet fabric 112 may be adjoined to an underlying sheet of



- reinforcement material 158 by one or more layers of a resilient polymeric adhesive material 160. The polymeric adhesive material 160 may be of either a thermoplastic or a thermosetting composition. Hot melt materials may be particularly preferred. By way of example only and not limitation, useful hot melts may include bitumen, polyolefin-based thermoplastics. One potentially preferred hot melt material is polyolefin based thermoplastic. Useful thermosetting adhesives may include polyurethanes. It is contemplated that the total mass of hot melt adhesive utilised within both layers adjacent the reinforcement material will preferably be in the range of about 20 to about 100 ounces per square yard (679 – 3395 g/m<sup>2</sup>) of carpet and will more preferably be present at a level of about 35 to about 90 ounces per square yard (1188 to about 3055 g/m<sup>2</sup>) of fabric.
- 10 The reinforcement material 158 serves to enhance dimensional stability across the carpet construction to substantially prevent the various layers from undergoing disproportionate dimensional change as the carpet construction is subjected to compressive forces during use and temperature changes during use and/or processing. The reinforcement material is preferably a sheet, mat or tissue incorporating multiple fibreglass (glass) fibres entangled in a non-woven
- 15 construction such as a 2 oz/ yd<sup>2</sup> (68 g/m<sup>2</sup>) construction and may be held together by one or more binders such as an acrylic binder. Such a construction is believed to provide substantially uniform load bearing characteristics in all directions, which may be beneficial in some instances. Other materials as may be utilised include glass scrim materials as well as woven or non-woven textile materials such as polyester or nylon.
- 20 As illustrated in FIGS. 3A, 3B and 3C, the polymeric adhesive material 160 is preferably disposed in covering relation on either side of the reinforcement material 158. It is contemplated that the adhesive material 160 will extend in covering relation away from each side of the reinforcement material 158. In this regard, it is contemplated that the adhesive material will preferably perform the dual functions of securing the reinforcement material 158 in place while simultaneously forming
- 25 a bonding bridge between the underside of the carpet fabric 112 and the upper surface of the cushioning foam or rebond foam 178.
- A preformed layer of, for example, polyurethane rebond foam or compressed particle foam 178 either with or without a backing layer 170 (FIGS. 3A and 3B) or a multi-component backing composite (FIGS. 10A-C) is bonded to, for example, a non-woven sheet of glass tissue,
- 30 reinforcement material 158 which has been covered on its underside with a lower coating of hot melt polymeric adhesive material 160. An additional upper coating of hot melt polymeric adhesive 160 is thereafter applied across the upper surface of the reinforcement material 158. Due to the high surface area and relatively porous nature of the non-woven reinforcement material, the polymeric adhesive 160 may extend at least partially through the reinforcement material while at
- 35 the same time establishing a stable mechanical bond therewith.

As described in U.S. Patent Nos. 5,312,888; 5,817,703; 5,880,165; and 6,136,870 rebond foam or rebond polyurethane foam is known in the art of isocyanate-based polymeric foams. Specifically, it is known to mix pieces of foam with a binder which serves to bond the pieces to one another.

R bonding technology has been used for a number of years to recycle, inter alia, polyurethane foams. Generally, a large particle size, low density, non-uniform density, rather frangible, rebonded polyurethane foam product has been used as broadloom carpet underlayment or pad, and in specific seating and cushioning applications.

- 5 In processes for preparing foam sheets, pads, blocks, or shaped polymer foams, waste foam can be produced. The waste foam can be from the fabricating process and represent the area/volume of the foam removed from the starting block stock (or loaf) such as the crust to form the shaped foam object. The waste foam can also be the crust, trimmings, scrapes, or off-specification products which are occasionally produced in some fabricating processes. It is desirable to recycle this waste foam.

Flexible polyurethane foam scrap can be chopped or chipped and then coated with a binder consisting of a polyisocyanate prepolymer having isocyanate functionality and a catalyst. The coated, chopped foam is compressed and then treated with steam to cure the binder to form a rebond foam sheet or other shape.

- 15 In another process for recycling or using flexible polyurethane foam waste, the flexible foam waste is cryogenically ground and blended back into the formulation used to prepare it. The ground flexible foam can be used at a level of about 20 percent within the polyol component of the polyurethane foam formulation.

- 20 It is preferred to use at least about 10-90% recycled foam or rebond foam containing at least about 10-100% recycled foam material and a binder, adhesive, or prepolymer (and one or more additives) to produce a carpet tile having at least about 10-100% recycled foam or cushion content, especially post industrial reclaimed foam or cushion content, in the foam or cushion layer thereof.

- 25 It is preferred to use a small particle size relatively high density rebond foam material formed by a process of shredding or grinding foam materials such as foam scrap or waste in a foam shredder to form foam particles which are fed to one or more storage hoppers (different densities, colours, types of foam particles can be stored in respective hoppers). The foam particles are fed from the hoppers to a blend tank wherein different colours, densities, types of particles are blended and mixed with one or more binders, adhesives, prepolymers and/or additives from one or more
- 30 reactors or tanks to form a blended, mixed, particle and binder slurry (for example about 85% particles, 15% binder). The slurry is fed to a large compression cylinder or vessel, is compressed (for example 2:1 - 4:1) and treated with heat and steam to set or cure the rebond foam in its compressed state (compressed particle foam). After cooling, the rebond foam log or block is removed from the cylinder and mounted in a peeling or slicing apparatus having a band knife or
- 35 other blade or device for cutting, slitting or peeling a rebond foam sheet or pad from the exterior of the log or roll.



The rebond foam sheet may have one or more materials laminated to the top and/or bottom surface thereof to form a foam or cushion composite which is laminated or attached to at least a carpet or tile material or face to form a carpet composite or product.

In accordance with the present invention, it is preferred to use a rebond foam having a backing, such as a scrim, woven or non-woven material on at least one surface.

In the preferred embodiment, the preformed foam layer 178 may include a backing material 170 such as woven or non-woven about 10% to 100% polyester/90%-0% polypropylene, preferably about 50% polyester/ 50% polypropylene non-woven fibrous material or felt such as is available from Synthetic Industries of Ringold, Georgia and which may contain a colorant or binder such as acrylic binder. While this represents the backing material of preference, it is to be understood that any number of alternative compositions or composites may likewise be utilized as dictated by requirements regarding shrinkage and installation. The commonly used secondary backing materials include non-woven polyester, non-woven polyester and polypropylene blends, or woven polypropylene. By way of example only, in instances where very little or no shrinkage may be tolerated, the backing material may be up to 100% polyester. Further, while a non-woven backing material may be preferred, it is contemplated that either woven or non-woven constructions may be utilized as can materials other than the polyester/polypropylene mix such as acrylic, nylon, fiberglass, and the like.

According to one potentially preferred arrangement, the foam density is about 16 lbs. per cubic foot ( $257 \text{ kg/m}^3$ ) or less with a thickness of about 0.06 inches (1.5mm) although it is contemplated that such levels may vary greatly depending upon desired product characteristics.

It is contemplated that the adhesive layer and the preformed foam or rebond cushion 178 may be the subject of a broad range of alternatives. By way of example only and not limitation, at least four options or examples of the adhesive layer and/or foam cushion material 178 are believed to be viable to yield commercially acceptable foam products using virgin polyurethane and/or recycled polyurethane chips, chunks, granules, etc.

1. Use of standard filled Polyurethane system as the virgin and/or rebond polyurethane. On polyurethane foam contains 110 parts of filler and is applied at a density of about 15 lbs/cu. ft. ( $241 \text{ kg/m}^3$ ). If the thickness is in the range of 0.04 - 0.12 inches (1 - 3 mm) and we determine polymer weight only, using the density and filler levels above, the weight range of the polymer would be 4.32 oz/sq yd to 12.96 oz/sq yd ( $146 - 440 \text{ g/m}^2$ ).

2. For the virgin and/or rebond polyurethane increase the filler levels and reduce the density to 13 lbs/cu. ft. ( $209 \text{ kg/m}^3$ ). At the same thickness limits the polymer weights would then be 2.72 - 8.24 oz/sq. yd ( $92 - 280 \text{ g/m}^2$ ).

3. Use an unfilled polyurethane (Prim urethane) system. High densities such as above are not possible with prime however they perform because of the wall structure and the fact that as



filler is present. If we consider a prim to be at 6 lbs/cu. ft. ( $96 \text{ kg/m}^3$ ) applied at the thickness limits above, the polymer weight would be 2.88 – 8.64 oz/sq. yd. ( $98 - 293 \text{ g/m}^3$ ).

4. Use a polyurethane system available under the trade designation KANGAHIDE from Textile Rubber which has only 15 parts of a filler material and is applied at 6 – 9 lbs/cu. ft. ( $96 - 144 \text{ kg/m}^3$ ) density, if a polymer calculation is again made at the described thickness limits it would be 4.3 – 13.02 oz/sq. yd. ( $146 - 442 \text{ g/m}^2$ ).

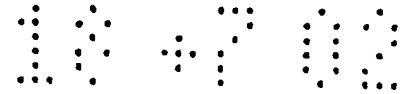
Although the above examples have to do with polyurethane, a water based foam system can also be used. Although a polyurethane rebond foam or compressed particle foam (formed of compressible particles, chips, crumbs, etc.) is preferred, it is understood that other compressible particles made from other foams (open cell, closed cell) or materials such as PVC foam, polyethylene foam, cork, rubber, and/or the like may be used.

A potentially preferred polyurethane-forming composition for use as the polymer adhesive and the virgin and/or rebond polyurethane chips in the rebond foam 178 of the present invention is disclosed in U.S. Pat. No. 5,104,693. Specifically, the preferred polyurethane-forming composition which is used as the virgin and/or rebond polyurethane in the rebond foam and/or which is applied across the surface of the foam layer 178 includes:

- A. At least one isocyanate-reactive material having an average equivalent weight of about 1000 to about 5000;
- B. An effective amount of blowing agent; and
- 20 C. A polyisocyanate in an amount to provide an isocyanate index of between about 90 and about 130, wherein at least 30 percent by weight of such polyisocyanate is a soft segment pre-polymer reaction product of a stoichiometric excess of diphenylmethane diisocyanate (MDI) or a derivative thereof and an isocyanate-reactive organic polymer having an equivalent weight of from about 500 to about 5,000 and wherein the prepolymer has an NCO content of about 10 to about 30 percent by weight.

The polyurethane-forming composition also preferably contains a silicone surfactant to improve frothability and stability in the form of an Organo-silicone polymer such as are disclosed generally in U.S. Pat. No. 4,022,941. Specifically, the preferred surfactant is preferably a linear siloxane-polyoxyalkylene (AB) block copolymer and specifically a polyalkyleneoxidemethylsiloxane copolymer. One such silicone surfactant which is particularly useful is available under the trade designation L-5614 from OSI Specialties, Inc. whose business address is believed to be 6525 Corners Parkway, Suite 311, Norcross, Ga. 30092.

A sufficient level of the silicone surfactant is used to stabilize the cells of the foaming reaction mixture until curing occurs. In general, the silicone surfactants are preferably used in amounts ranging from about 0.01 to about 2 parts-per hundred parts by weight of component (A) and more



preferably from about 0.35 parts to about 1.0 parts by weight of component (A) and most preferably from about 0.4 to 0.75 parts per hundred parts by weight of component (A).

As will be appreciated, there may be created a substantial number of alternative embodiments and configurations for foam backed or cushioned carpeting or carpet tile that may incorporate features of the present invention. As illustrated in FIGS. 6A and 6B, wherein like components to those previously described are designated by corresponding reference numerals within a 600 series, it is contemplated that tufted loop pile and tufted cut pile constructions 610A and 610B include a first layer of hot melt adhesive 660 which extends away from the backing 622 and into contact with a sheet of reinforcement material 658 such as the non-woven glass or scrim material previously described. Thus, the first layer of hot melt adhesive 660 serves the function of securing the tufts 620, 621 in place relative to the backing 622 thereby avoiding the need to utilize a separate latex or hot melt pre-coat. A second layer of hot melt adhesive 660 extends away from the reinforcement material 658 into contacting relation with the foam cushion or rebond material 678 to establish a bonding relation between the carpet 612 and the foam cushion or rebond material 678. Accordingly, a single adhesive layer extends between the upper surface of the reinforcement material 658 and the underside of the backing 622.

As illustrated in FIGS. 7A, 7B and 7C wherein like components to those previously described are designated by corresponding reference numerals within a 700 series, it is contemplated that tufted loop pile construction 710A, tufted cut pile construction 710B, and bonded cut pile construction 710C include a first layer of resilient adhesive 760 extending away from the upper surface of a layer of reinforcement material 758 and which may be of a different character from a second layer of resilient adhesive 760' extending away from the lower surface of the reinforcement material. In all other respects, the configuration is substantially as illustrated and described in relation to FIGS. 3A, 3B and 3C or 6A and 6B. By way of example only and not limitation, in the event that the reinforcement material 758 is disposed between two different adhesives, it is contemplated that the adhesive 760 extending away from the upper surface of the reinforcement material 758 may be, for example, hot melt, while the adhesive 760' extending away from the lower surface of the reinforcement material 758 may be, for example, polyurethane forming composition. Also, adhesive 760 of FIGS. 7A and 7B may be multiple layers of the same adhesive.

In FIGS. 8A and 8B wherein like components to those previously described are designated by corresponding reference numerals within an 800 series, there are illustrated yet additional potential embodiments of the present invention. In such embodiments, tufted loop pile construction 810A and tufted cut pile construction 810B include a layer of reinforcement material 858 disposed between a first layer of latex adhesive 824 extending away from the upper side of the reinforcement material 858 and a second layer of latex adhesive 824 extending away from the lower side of the reinforcement material 858. Thus, latex extends substantially between the upper surface of the cushion or foam 878 and the backing 822 with the layer of reinforcement material 858 disposed within such latex at an intermediate position. Such latex is preferably a

carboxylated styrene butadiene rubber (SBR) latex. Of course it is also contemplated that similar constructions utilising other adhesives such as ethylene vinyl acetate (EVA), and acrylics as well as hot melts or polyurethanes as previously described may be useful.

As previously indicated, it is contemplated that additional stability may be applied to the construction of the present invention by incorporating stabilising elements in intimate relation to the backing of a tufted carpet. Exemplary embodiments incorporating such a configuration are illustrated in FIGS. 9A and 9B wherein like components to those previously described are designated by corresponding reference numerals within a 900 series. As illustrated therein, tufted loop pile construction 910A and tufted cut pile construction 910B include pile forming yarns 920, 921 tufted through a backing 922 which incorporates therein a non-woven or scrim backing stabilising layer 923. The backing stabilising layer 923 may be adjoined to the backing 922 by a needling or calendering operation. In addition, point bonding may be achieved between the structures by incorporating heat activated adhesive fibres within the non-woven construction. In the event that a construction incorporating a backing stabilising layer is utilised, it is contemplated that the pre-coat 924 and/or the reinforcement material 958 may be substantially reduced or even eliminated entirely if desired due to the stability imparted to the enhanced backing 922, 923.

In FIGS. 10A-C there are illustrated several potential preferred embodiments 1010A, 1010B, 1010C wherein like components to those previously described are designated by corresponding reference numerals within a 1000 series. As will be appreciated, such embodiments correspond substantially to those illustrated and described in relation to FIGS. 3A-C with the exception that the backing material 1070 is not in direct contacting relation to the foam cushion or rebound foam 1078. Rather the backing is bonded or laminated to the foam by an adhesive or a multi-component composite backing applied across the underside of the foam cushion 1078. According to the relatively simple embodiment illustrated, such composite backing 1070, 1071 includes a relatively thin layer of hot melt or other resilient adhesive 1071 extending in bonding relation between the underside of the foam cushion 1078 and the backing material 1070 of woven or non-woven construction as previously described. The thickness of such hot melt or other resilient adhesive is preferably not greater than about 40 oz/ yd<sup>2</sup> (1358 g/m<sup>2</sup>) and will most preferably be about 20 oz/ yd<sup>2</sup> (679 g/m<sup>2</sup>) or less. As will be appreciated, it is contemplated that the multi-component composite may include virtually any number of layers of different materials including by way of example only and not limitation, release layers, additional adhesive layers, magnetic layers and/or stabilising layers in various arrangements as may be deemed useful. Moreover, while the multi-component composite backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that such composite backings may likewise be used in any number of other constructions including, for example, those of FIGS. 6A-B, 7A-C, 8A-B, or 9A-B, but not limited to those previously described hereinabove.

Yet another set of alternative configurations are illustrated in FIGS. 11A-C wherein like components to those previously described are designated by corresponding reference numerals within an 1100 series. As illustrated, these embodiments 1110A, 1110B, 1110C correspond substantially with those of FIGS. 3A-C except that the foam cushion or rebond foam 1178 is substantially free of any supplemental backing. As will be appreciated, while the absence of a supplemental backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that such practices may likewise be used in any number of other constructions including, for example, those of FIGS. 6A-B, 7A-C, 8A-B, 9A-B, or 10A-C but not limited to those previously described.

In FIGS. 12A-C there are illustrated several alternative embodiments wherein like components to those previously described are designated by corresponding reference numerals within a 1200 series. As will be appreciated, such embodiments 1210A, 1210B, 1210C correspond substantially to those illustrated and described in relation to FIGS. 3A-C with the exception that the backing material 1270 includes a thin layer of tacky releasable adhesive 1287 and access layer 1289 disposed across the undersurface. The thin access layer 1289 of paper or other suitable film or material is disposed in peel-away relation below the releasable adhesive so as to permit an installer to expose the releasable adhesive during installation. As will be appreciated, such releasable or peel and stick adhesive provides a relatively weak bond in tension while providing a stronger bond in shear such that a carpet element such as a carpet tile can be pulled away from an underlying surface but will be substantially resistant to undesired sliding movement. The weight of such releasable adhesive is preferably not greater than about 20 oz/ yd<sup>2</sup> (679 g/m<sup>2</sup>) and will most preferably be about 5 oz/ yd<sup>2</sup> (170 g/m<sup>2</sup>) or less.

As will be appreciated, while the releasable adhesive backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that adhesive backings may likewise be used in any number of other constructions including but not limited to the constructions of FIGS. 6A - B, 7A - C, 8A - B, and 9A - B as well as those having bare foam undersides in FIGS. 11A-C.

As shown in FIGS. 13A-C wherein like components to those previously described are designated by corresponding reference numerals within a 1300 series, it is contemplated that carpet constructions 1310A, 1310B, 1310C include a releasable adhesive backing 1387, and access layer 1389 may be incorporated as the lower surface elements of a multi-component composite backing 1370, 1371 as previously described in relation to FIGS. 10A-C.

Alternative examples of a tufted carpet product 1400 is illustrated in FIG. 14A and of a bonded carpet product 1410 is illustrated in FIG. 14B.

In the tufted carpet of Figure 14A, a carpet fabric 1412 is embedded in an adhesive layer 1416 in which is embedded a layer of glass scrim 1418. A rebond foam base composite 1419 is likewise adhesively bonded to the adhesive layer 1416. In the tufted carpet illustrated in FIG. 14A, the

carpet fabric 1412 includes a loop pile layer 1420 tufted through a backing 1422 by a conventional tufting process and held in place by a pre-coat backing layer of latex 1424 or other appropriate adhesives including a hot melt adhesive or the like. The rebond foam base composite 1419 of the tufted carpet product 1400 includes a backing layer 1426 moulded, bonded, or laminated to a layer of urethane rebond foam 1428 as illustrated.

The bonded carpet product 1410 (FIG. 14B) employs the same type of rebond foam base composite 1419 adhesively bonded by adhesive laminate layers 1416. However, the bonded carpet fabric 1412 has somewhat different components from that of the tufted product in that it has cut pile yarns 1434 implanted in a PVC, latex, or hot melt adhesive 1436 having a glass scrim reinforcement layer 1438.

It is preferred that the backing layer or material 1626 be laminated to the foam 1428 by flame lamination. Alternatively, it may be attached by one or more adhesives (FIGS. 10A – 10C).

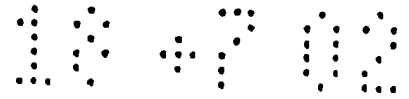
Alternative examples of a tufted carpet product 1500 is illustrated in FIG. 15A and of a bonded carpet product 1510 is illustrated in FIG. 15B.

In the tufted carpet of Figure 15A, a carpet fabric 1512 is attached to an adhesive layer 1560. A rebond foam base composite is likewise adhesively bonded to the adhesive layer 1560. In the tufted carpet illustrated in FIG. 15A, the carpet fabric 15412 includes a loop pile layer 1520 tufted through a backing 1522 by a conventional tufting process and held in place by a pre-coat backing layer of latex 1524 or other appropriate adhesives including a hot melt adhesive or the like. The rebond foam base composite of the tufted carpet product 1500 includes a reinforcement layer 1558 and a backing layer 1570 moulded, bonded, or laminated to respective sides of a layer of urethane rebond foam 1528.

In at least one bonded carpet construction of the present invention (FIG. 15B), the carpet fabric 1512 preferably comprises a plurality of cut pile yarns 1534 implanted in a latex or hot melt adhesive 1536 which is laminated to a glass scrim reinforcement or substrate layer 1538. It is contemplated that this substrate layer 1538 may be pre-coated with latex or other thermoplastic polymers to permit melting adhesion with the cut pile yarns 1534 upon the application of heat, thereby potentially reducing or eliminating the need for the latex or hot melt adhesive 1536.

In the illustrated embodiment of FIGS. 15A, 15B, the layer of reinforcement material 1558 is adjacent to and preferably at least partially embedded in the layer of rebond polyurethane 1578. That is, the reinforcement material 1558 is in intimate contact with the polyurethane 1578 such that the polymer material will hold the reinforcement in place.

It will be appreciated that a number of alternative practices may be incorporated into the present invention yielding slightly different products. By way of example only, the reinforcement material may be left completely out of the process thereby making the use of at least adhesive layer



rebond cushion or cushion composite thereby yielding a composite structure as illustrated in FIGS. 16A, 16B, 26, and 27 with the polyurethane rebond foam 1678 or upper layer (fibreglass) immediately adjacent to the carpet fabric 1612. It is preferred that the rebond foam be laminated by flame lamination.

- 5 In accordance with another embodiment, a hot melt or adhesive layer may be used to mate the carpet to the cushion layer with or without the reinforcement material (FIGS. 19A, 19B, 22, 23, 24, 25).

In yet another alternative, the cushion backing may have an adhesive quick release backing attached to the face to which the polyurethane-forming composition is not applied. Moreover, it is  
10 contemplated that in some instances the backing might be completely eliminated such that the polyurethane rebond cushion would directly contact the flooring (FIGS. 25, 26, 27) as disclosed in relation to U.S. Pat. No. 4,286,003.

Although it is preferred for the tufted modular carpet or modular carpet tile of the present invention to have at least the following layers: yarn, backing, latex pre-coat adhesive, hot melt adhesive,  
15 fibreglass, rebond foam, and felt (FIG. 14A), it is contemplated that one or more of these layers may be eliminated or substituted for and still provide a carpet or tile having the desired properties or characteristics. For example, the latex pre-coat adhesive layer may be replaced by a bitumen hot melt layer (FIG. 20), the felt layer may be eliminated on a free lay (no floor adhesive) installation product (FIGS. 25, 26, 27), the glass layer may be eliminated (FIG. 21, 26), or the like.  
20 It should be noted that although the embodiment of Fig 26 is described in relation to a latex on the foam it could alternatively be a hot melt applied to the foam.

With reference to FIG. 22, the carpet construction may include two or more layers of rebond foam. In particular, the foam backing of FIG. 22 includes a fibreglass layer sandwiched between two rebond foam layers and a felt backing on the bottom. Such a foam composite may be formed by  
25 flame lamination of the layers one to another

With reference to FIG. 36 of the drawings, a woven carpet construction or product 3610 includes a woven material 3620 attached to a rebond foam layer 3678 by an adhesive or pre-coat 3624. Further, a backing material 3670 is attached to the foam layer 3678 by, for example, flame lamination.

30 With reference to FIG. 37, a non-woven carpet construction or product 3710 includes a non-woven material 3734, two adhesive layers 3760, a scrim material 3738, a reinforcement material 3758, a rebond foam layer 3778, and a backing material 3770. Adhesive layers 3760 attach the non-woven material 3734 to the backing composite 3758, 3778, 3770 (FIGS. 31 and 32).

With reference to FIGS. 33 and 34, a conventional filled polyurethane foam carpet tile cushion  
35 comprises an open cell or substantially open cell polyurethane foam formed by mechanical frothing and heat curing (FIG. 33)

A preferred rebond foam material of the present invention such as a small chip size, high density polyurethane rebond foam has a reticulated or skeletal structure with substantially all of the cell walls blown out (FIG. 34). FIGS. 33 and 34 are cross-section micrographs taken at about 30 times magnification.

5 In accordance with the present invention, it was unexpectedly discovered that a small chip size, high density rebond foam layer or sheet made an excellent cushion back carpet tile construction in place of conventional filled polyurethane foam. Also, it was unexpectedly discovered that a carpet tile containing such a rebond foam layer exhibited excellent comfort, wear, durability, sound deadening, cushion, comfort, resiliency, look, feel, seamability, and the like characteristics or performance. In other words, such a rebond foam containing carpet tile performed substantially as well as or better than conventional carpet tiles containing filled polyurethane foam or other conventional foams or cushions.

15 With reference to FIG. 35, the polyurethane rebond foam containing tufted carpet tile of the present invention performed as well as or better than a conventional filled polyurethane containing tufted carpet tile (same face). Also, both cushioned tiles performed better than a hardback tile. The cushion backing tends to save the face of the tile, as well as provides under foot comfort, sound deadening, and anti-fatigue properties.

A feature of the present invention is that it incorporates rebond or recycled product. The urethane chips are usually a low density variety such as 1-3 lb/cu. ft. ( $16 - 48 \text{ kg/m}^3$ ) and may contain a low amount of high density foam crust pieces. After the compression and gluing takes place, the density can be as high as 15 lb/cu. ft. ( $241 \text{ kg/m}^3$ ) or more. Then this log is cut, slit or peeled into roll lengths of almost any thickness. Then the lengths of foam are taken to a flame laminator and the non-woven secondary and the glass is bonded to each side of the rebond cushion and again rolled up. The only step required from this point is the lamination of this composite to the pre-coated tufted carpet or to use a hot melt adhesive and the result is a cushion tile using waste or recycled foam material.

For rebond carpet tile we have found that it is preferred to use as close a density and thickness as other cushion back carpet tile as possible and also to decrease substantially the chip size. As chip size is decreased, the foam backing is much more attractive, stronger, and more uniform.

30 In accordance with one particular embodiment of the present invention, a preformed rebond foam or pad is used to manufacture a commercial grade cushion carpet tile. A rebond pad of approximately 13 pounds/cubic foot ( $209 \text{ kg/m}^3$ ) density is modified to have a respective non-woven material bonded to one surface thereof.

35 The following tables represent exemplary embodiments or examples of foam layer specifications of the present invention.

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**A. Commercial Premises Carpet Tile Rebond Foam Specifications**

Foam Weight	14.5 oz/ yd <sup>2</sup> (232 g/m <sup>2</sup> )
Foam Density	8 lbs./ft <sup>3</sup> (128 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	4 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15% by weight
Chips	82-85% by weight
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Colorant (may be added)	Milliken Reactint® polyurethane colorant at about 3% of binder weight

**B. Commercial Premises Carpet Tile Rebond Foam Specifications**

Foam Weight	7.75 oz/ yd <sup>2</sup> (124 g/m <sup>2</sup> )
Foam Density	8 lbs./ft <sup>3</sup> (128 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	2 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15% by weight
Chips	82-85% by weight
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Colorant (may be added)	Milliken Reactint® polyurethane colorant at about 3% of binder weight

**5 C. Residential/Hospitality Carpet Tile Rebond Foam Specifications**

Foam Weight	27.1 oz/yd <sup>2</sup> (920 g/m <sup>2</sup> )
Foam Density	8 lbs./ft <sup>3</sup> (128 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	7mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15%
Chips	82-85%
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Colorant (may be added)	Milliken Reactint® polyurethane colorant at about 3% of binder weight

**D. Commercial Carpet Tile Rebond Foam Specification Ranges**

Foam Weight	7 – 50 oz/yd <sup>2</sup> (238 – 3055 g/m <sup>2</sup> )
Foam Density	4 – 16 lbs./ft <sup>3</sup> (64 – 257 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	2 – 7 mm
Uncompressed Chip Size	2 – 14 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	5 – 20%
Chips	60 – 95%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	2:1 – 5:1
Additives such as colorant, fiber, fill, etc.	0-20%

**E. Preferred Commercial Carpet Tile Rebond Foam Specification Ranges**

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Foam Weight	10 – 18 oz/yd <sup>2</sup> (339 – 611 g/m <sup>2</sup> )
Foam Density	7 – 12 lbs./ft <sup>3</sup> (112 – 193 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	2 – 5 mm
Uncompressed Chip Size	5 – 8 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	12 – 17%
Chips	78 – 88%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	3:1
Additives such as colorant, fill, fiber, etc.	0-5%

**F. Residential/Hospitality Carpet Tile Rebond Foam Specification Ranges**

Foam Weight	7 – 84 oz/yd <sup>2</sup> (238 – 2852 g/m <sup>2</sup> )
Foam Density	4 – 16 lbs./ft <sup>3</sup> (64 – 257 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	2 – 10 mm
Uncompressed Chip Size	2 – 14 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	5 – 20%
Chips	60 – 95%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	2:1 – 5:1
Additives such as colorant, fill, fiber, etc.	0-20%

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**G. Preferred Residential/Hospitality Carpet Tile Rebond Foam Specification Ranges**

Foam Weight	10 – 30 oz/yd <sup>2</sup> (339 – 1018 g/m <sup>2</sup> )
Foam Density	6 – 10 lbs./ft <sup>3</sup> (96 – 160 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	5 – 8 mm
Uncompressed Chip Size	5 – 8 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	12 – 17%
Chips	83 – 88%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	3:1
Additives such as colorant, fill, fiber, etc.	0-5%

**5 H. Carpet Tile Rebond Foam Specifications**

Foam Weight	14.5 oz/yd <sup>2</sup> (233 g/m <sup>2</sup> )
Foam Density	8 lbs./ft <sup>3</sup> (128 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	4 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15%
Chips	80-85%
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Additives such as filler, colorant, fiber, etc.	0-5%

**I. Flame Laminated Carpet Tile Rebond Foam Specifications**

Foam Density	9 lbs./ft <sup>3</sup> (144 kg/m <sup>2</sup> )
Foam Thickness (prelamination)	4-4.5 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam (minimum 25% polyester)
Binder or Prepolymer	10 - 15%
Chips	85 – 90%
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1

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**J. Hot Melt Laminated Carpet Tile Rebond Foam Specifications**

Foam Density	9 lbs./ft <sup>3</sup> (144 kg/m <sup>2</sup> )
Foam Thickness (prelamination)	4 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam (can be 100% polyether)
Binder or Prepolymer	10 - 15%
Chips	85 - 90%
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1

**K. Carpet Tile Rebond Foam Specifications**

Foam Weight	14.5 oz/yd <sup>2</sup> (233 kg/m <sup>2</sup> )
Foam Density	8 lbs./ft <sup>3</sup> (128 kg/m <sup>3</sup> )
Foam Thickness (prelamination)	4 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	10 - 20%
Chips	80-90%
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Additives (colorant, filler, anti-microbial agent, flame retardant, anti-fungal agent, fillers, solid particles, and/or the like)	0 - 10%

- 5 U.S. Patent No. 5,929,145 describes bitumen backed carpet tile and bitumen compositions suitable for carpet tile backing. The foam backed or cushion backed carpet tile of the present invention preferably provides sound deadening especially over raised access flooring, reduced drum h ad noise, comfort, durability, anti-fatigue, cushioning, excellent design or pattern registration, hidd n seams, recycled content, and/or the like.

10

In accordance with one embodiment the latex pre-coat is replaced with a hot melt pre-coat such as shown in FIGS. 6A, 6B, 7A, 7B, 39, and with the backing attached to the foam by an adhesive as shown in FIGS. 10A, 10B, 39, and 40.

- 15 The invention may b further understood by r fer nce to the following non-limiting examples:

**EXAMPLE I**

A tufted carpet til is produced with the configuration illustrated and d scribed in relation to FIG. 3A has the following specification:

Yarn	15 oz/yd <sup>2</sup> (509 g/m <sup>2</sup> ) nylon 6,6 loop pile continuous filament
Backing	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) non-woven polyester
Pre-coat	6 oz/yd <sup>2</sup> (204 g/m <sup>2</sup> ) SBR Latex filled with 100 parts CaCO <sub>2</sub>
Hot Melt Adhesive	42 oz/yd <sup>2</sup> (1426 g/m <sup>2</sup> ) modified polypropylene
Laminate Reinforcement	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) Non-woven glass with acrylic binder
Urethane Rebond Foam Coverage	20 oz/yd <sup>2</sup> (679 g/m <sup>2</sup> )
Urethane Rebond Foam Density	16 pounds per cubic foot (257 kg/m <sup>3</sup> )
Backing Material	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) Non-woven (50% polypropylene, 50% polyester)

**EXAMPLE II**

Construction	Tufted, Textured Loop Pile
Face Fiber	100% Milliken Certified WearOn® Nylon
Soil Protectant	MilliGuard®
Antimicrobial	BioCare®
Dye Method	Millitron® Dye Injection Printing
Gauge	1/10 in. (39.4/10cm.)
Rows	14.4/in. (56.7/10cm.)
Tufts	143.9/sq.in. (2230.3/100 sq.cm.)
Standard Backing cushion	PVC-Free UNDERSCORE™
Nominal Total Thickness	0.34 in. (8.6mm)
Total Weight	99.9 oz./sq.yd. (3,387.4 g./sq.m.)
Tile Size	36 X 36 in. (914.4 X 914.4mm)
Flammability (Radiant Panel ASTM-E-648)	≥0.45 (Class I)
Smoke Density (NFPA-258-T or ASTM-E-662)	≤450
Methenamine Pill Test (CPSC FF-1-70 or ASTM D 2859)	Self-Extinguishing
Lightfastness (AATCC 16E)	≥4.0 at 80 hrs
Crocking (AATCC 165)	≥4.0 wet or dry
Static Electricity (AATCC-134) 20% R.H., 70°F	≤3.5 KV
Dimensional Stability – Aachener test (DIN Standard 54318)	≤0.2%
Recommended Traffic	Heavy Commercial

Recommended Maintenance	Millicare®
CRI Indoor Air Quality	Product Type: 12200793
Foam	Rebond Foam

**EXAMPLE III**

A tufted carpet is produced with the configuration illustrated and described in relation to FIG. 3A.  
The specifications are as follows:

5

Yarn	29 oz/yd <sup>2</sup> (985 g/m <sup>2</sup> ). nylon 6,6 loop pile continuous filament, white, 1350 denier, not plied, not twisted, not heat set
Backing	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) non-woven polyester
Pre-coat	16 oz/yd <sup>2</sup> (543 g/m <sup>2</sup> ). SBR Latex filled with 100 parts CaCO <sub>2</sub> .
Hot Melt Adhesive	36 oz/yd <sup>2</sup> (1222 g/m <sup>2</sup> ) modified polypropylene
Laminate Reinforcement	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) Non-woven glass with acrylic binder
Urethane Rebond Foam Coverage	15 oz/yd <sup>2</sup> (509 g/m <sup>2</sup> )
Urethane Rebond Foam Density	16 pounds per cubic foot (257 kg/m <sup>3</sup> )
Backing Material	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) Non-woven (50% polypropylene, 50% polyester)

**EXAMPLE IV**

A tufted carpet was produced with the configuration illustrated and described in relation to FIG. 3A.  
The specifications are as follows:

10

Yarn	24 oz/yd <sup>2</sup> (815 g/m <sup>2</sup> ) nylon 6,6 loop pile continuous filament
Backing	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) non-woven polyester
Pre-coat	14 oz/yd <sup>2</sup> (475 g/m <sup>2</sup> ) SBR Latex filled with 100 parts CaCO <sub>2</sub>
Hot Melt Adhesive	38 oz/yd <sup>2</sup> (1290 g/m <sup>2</sup> ) modified polypropylene
Laminate Reinforcement	3 oz/yd <sup>2</sup> (102 g/m <sup>2</sup> ) Non-woven glass with acrylic binder
Urethane Rebond Foam Coverage	22 oz/yd <sup>2</sup> (747 g/m <sup>2</sup> )
Urethane Rebond Foam Density	9 pounds per cubic foot (144 kg/m <sup>3</sup> )
Backing Material	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) Non-woven (50% polypropylene, 50% polyester)

**EXAMPLE V**

A tufted carpet was produced with the configuration illustrated and described in relation to FIG. 6A. The specifications are as follows:

Yarn	40 oz/yd <sup>2</sup> (1358 g/m <sup>2</sup> ) nylon 6,6 loop pile
Backing	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) non-woven polyester
Laminate Reinforcement	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) Non-woven glass with acrylic binder
Urethane Rebond Foam Coverage	36 oz/yd <sup>2</sup> (1222 g/m <sup>2</sup> )
Urethane Rebond Foam Density	16 pounds per cubic foot (257 kg/m <sup>3</sup> )
Backing Material	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) Non-woven (50% polypropylene, 50% polyester)

#### 5 EXAMPLE VI

A tufted carpet was produced with the configuration illustrated and described in relation to FIG. 18. The specifications are as follows:

Yarn	15 oz/yd <sup>2</sup> (509 g/m <sup>2</sup> ) nylon 6,6 loop pile continuous filament, white, 1350 denier, not plied, not twisted, not heat set
Backing	4 oz/yd <sup>2</sup> (136 g/m <sup>2</sup> ) non-woven polyester
Pre-coat	16 oz/yd <sup>2</sup> (543 g/m <sup>2</sup> ) SBR Latex filled with 100 parts CaCO <sub>2</sub>
Reinforcement Material	2 oz/yd <sup>2</sup> (68 g/m <sup>2</sup> ) Non-woven glass with acrylic binder
Urethane Rebond Foam Coverage	20 oz/yd <sup>2</sup> (679 g/m <sup>2</sup> )
Urethane Rebond Foam Density	16 pounds per cubic foot (257 kg/m <sup>3</sup> )

10 In one survey of 64 people rating carpet tiles for walking and standing comfort, the rebond foam containing bonded carpet tiles of the present invention scored higher for comfort (over 75% of the participants ranked the rebond tiles as their number one choice for comfort) than conventional filled polyurethane containing bonded carpet tiles or conventional bonded hard back carpet tiles (same face).

15

In another survey of over 75 participants, the number one choice for comfort was rebond foam containing carpet tiles (7 mm thick, 9 lb. Density (144 kg/m<sup>3</sup>), 7 mm chip size, polyurethane rebond foam) as compared to conventional filled polyurethane containing carpet tiles, rebond foam containing carpet tiles with less foam (4 mm thick, 9 lb. Density (144 kg/m<sup>3</sup>), 7 mm chip size, polyurethane), rebond foam containing tiles with even less foam (2 mm thick, 9 lb. Density (144 kg/m<sup>3</sup>), 7 mm chip size, polyurethane), and lastly conventional vinyl hardback carpet tiles (same face). In this survey, about 89% chose the thick rebond foam tiles as providing the most comfort, and about 11% chose the medium rebond foam tiles as providing the most comfort.

20

**Apparatus:**

WIRA instrumentation hexapod tumbler carpet tester. ASTM D-5252 Hexapod Drum Tester.

5 ISO/TR 10361 Hexapod Tumbler

**Procedure:**

The test specimen of rebond cushion carpet tile is subjected to the reported cycles of "Hexapod" tumbling, removing the specimen every 2,000 cycles for restoration by vacuuming.

10

An Electrolux upright vacuum cleaner (Discovery II) is used, making four (4) forward and backward passes along the length of the specimen.

The samples are assessed using daylight equivalent vertical lighting (1500 lux). Samples are viewed at an angle of 45 degrees from 1 ½ meter distance, judging from all directions.

15

**TEST RESULTS**

Number of Hexapod Cycles	4000	12000	Key to Ratings
Color Change	4-4.5	3-3.5	5 = Negligible or no change
			4 = Slight change
Overall Appearance	4	3	3 = Moderate change
			2 = Considerable change
			1 = Severe change

Ratings Based on CRI TM-101 Photographic Scales

20 **Comfort Ratings**

**Gmax Test Results:**

25 Gmax –simulates footfall onto a surface. The measure is reported as multiples of "g" (gravities), or Gmax. The lower the value, the lower the force upon impact, and the more comfortable underfoot the product feels. The higher the value, the higher the force upon impact, and the less comfortable the carpet feels.

Standard Milliken ComfortPlus cushion-backed carpet tile	- 116
30 Rebond cushion backed carpet tile of the present invention (same face and cushion thickness as Standard Milliken ComfortPlus® cushion)	- 121
Standard commercial broadloom without underlayment	- 185
Standard hardback carpet tile, such as Everwher a PVC hardback	- 227

### **Resilience Rating/Ball Bounc :**

5 Cushion Resilience – Cushion resiliency measures the rebound percent of a metal ball when dropped from a standard height. It shows the shock absorbing character of the cushion, which helps reduce visible wear of the carpet face. The higher the value, the higher the rebound percent, and the more resilient the cushion.

	Standard Milliken ComfortPlus® cushion backed carpet tile	– 30
10	Rebond polyurethane cushion back carpet tile of the present invention (same face and cushion thickness as Standard Milliken ComfortPlus® cushion)	– 29
	Standard commercial broadloom without underlayment	– 17
	Standard hardback carpet tile	– 13

### **15 Appearance Retention**

Appearance Retention Rating (ARR) – the ARR value is determined by grading the appearance change of carpet subjected to exposure conditions in accordance with either the ASTM D-5252 (Hexapod) or ASTM D-5417 (Vettermann) test method using the number of cycles for short and  
20 long-term tests specified.

ARR – Light (short-term  $\geq 3.0$ , long-term  $\geq 2.5$ )

ARR – Moderate (short-term  $\geq 3.5$ , long-term  $\geq 3.0$ )

ARR – Heavy (short-term  $\geq 4.0$ , long-term  $\geq 3.5$ )

25

The rebond foam modular carpet tile of the present invention had an APR of about 4.5 short term and 3.5 long term.

### **Durability**

30

The polyurethane rebond cushion back carpet tile of the present invention is very durable and can withstand 25,000 cycles or more of the castor chair test without failure.

EN 1307: Classification of pile carpets. This standard sorts carpets into four categories, depending  
35 on their ability to withstand differing degrees of wear. The categories are:

	Class 1	Light intensity of use (domestic only).
	Class 2	General (domestic or very light contract).
	Class 3	Heavy, e.g. use in general contract areas.
40	Class 4	Very Heavy, e.g. use in Extra heavy contract areas.

Three test methods are combined to provide the classification:

1. Fuzzing or loss of mass, on the step - scuff test EN 1963.
  2. I (tr) according to EN 1963. The carpet is shorn down to the backing, and various parameters such as Surface Pile weight and height, Surface pile density are measured. I (tr) is a numerical value calculated according to a mathematical formula which includes the above test measurements. The required value of I (tr) is higher the higher the classification.
  3. Hexapod or Vettermann drum test for change in surface appearance, ISO/TR 10361. Again, the higher the class, the higher the requirement.
- In addition, there are requirements for either minimum Surface Pile weight, or Surface Pile density for contract-grade carpets. This system is used for carpets with low, dense pile. There is a different system for carpets with high pile.

It is preferred to have a carpet composite or tile with a castor chair rating of >2.3 (test and evaluation method EN 54324.) A 2.4 or higher is a contract rating. It is preferred to have a carpet composite or tile with EN 1307 rating of >2. It is preferred to have a carpet composite or tile with Herzog walking comfort rating for contract use (DIN 54327) of >0.7.

PV C	Rebond Foam	Filled Polyurethane	All tufted loop construction where higher value is most comfortable
0.71	0.80	0.77	Walking comfort for domestic use
0.96	1.04	0.97	Walking comfort for contract use

- Hexapod test (ISO 10361 Method B) results are: 4,000 revs rating 4.5  
12,000 revs rating 4.0 for tufted  
3.5 for bonded overall Class 4

- Castor Chair test (EN 985) results are: 5,000 revs rating 3.0 tufted 2.5 bonded  
25,000 revs rating 2.5 tufted, 2.0 bonded  
overall valu 2.9 tufted, 2.4 bonded

Carpet Tile with R bond Foam

	<u>2mm r bond foam</u>	<u>4mm rebond foam</u>	<u>7mm r bond foam</u>
H xapod			
2000 cycles	5.0	4.5	5.0
4000 cycles	4.5	4.5	4.5
8000 cycles	4.0	4.0	3.5
12000 cycles	3.0	3.5	3.5
24000 cycles	2.5	3.0	3.0
48000 cycles	2.5	2.5	3.0
Caster Chair	3.5	3.0	4.5
Gmax	140	104	79.6
Ball Bounce	29.1	29.5	29.2

The carpet tile face for each was a 20 oz. (679 g/m<sup>2</sup>) , loop pile, 1/8 gauge tufted, nylon 6,6 and the construction was like that of FIGS. 15A or 19A.

5

Foam Tests	9 lb. (144 kg/m <sup>3</sup> ) small chip Rebond foam	Filled Polyurethane	8 lb. (128 kg/m <sup>3</sup> ) large chip Rebond foam
Compression Set	7.0%	5.1%	11.8%
Compression Resistance	2.8 psi (0.19 bar)	6.5 psi (0.44 bar)	14.4 psi (0.97 bar)

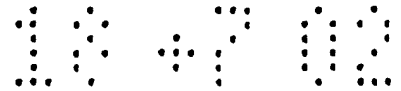
10

It is, of course, to be appreciated that while several potentially preferred embodiments, procedures and practices have been shown and described, the invention is in no way to be limited thereto, since modifications may be made and other embodiments of the principles of this invention will occur to those skilled in the art to which this invention pertains. Therefore, it is contemplated by the appended claims to cover any such modifications and other embodiments as may incorporate the features of this invention within the true spirit and scope thereof.



### Claims

1. A carpet tile comprising a carpet and a cushion comprising compressible particles bonded together with a binder, the cushion being attached to and below the carpet.
2. A carpet tile according to claim 1 in which the cushion is a foam cushion.
3. A carpet tile as claimed in claim 1 or claim 2, wherein the binder quantity is 25% or less by weight.
4. A carpet tile as claimed in claim 3, wherein the binder quantity is 15% or less by weight.
5. A carpet tile as claimed in claim 4, wherein the binder quantity is 10% or less by weight.
6. A carpet tile as claimed in any preceding claim, wherein the carpet has a face weight of 20 - 60 oz/yd<sup>2</sup> (679 - 2037 g/m<sup>2</sup>).
7. A carpet tile as claimed in one of claims 1 to 5, wherein the carpet has a face weight of 12 - 20 oz/yd<sup>2</sup> (407 - 679 g/m<sup>2</sup>).
8. A carpet tile as claimed in any one of claims 1 to 5, wherein the carpet has a face weight of less than or equal to 55 oz/yd<sup>2</sup> (1867 g/m<sup>2</sup>).
9. A carpet tile as claimed in claim 8, wherein the carpet has a face weight less than or equal to 45 oz/yd<sup>2</sup> (1528 g/m<sup>2</sup>).
10. A carpet tile as claimed in claim 1, wherein the carpet is at least one of a tufted, bonded, flocked, needle punched, and woven carpet.
11. A carpet tile as claimed in claim 2, further comprising at least one layer of adhesive material between said carpet and said foam cushion.
12. A carpet tile as claimed in claim 11, further comprising a layer of reinforcing material disposed within the layer of adhesive material such that at least a portion of the layer of adhesive material extends away from at least one side of the layer of reinforcing material.
13. A carpet tile as claimed in claim 11 or claim 12, wherein the adhesive material comprises at least one of a thermoplastic and thermoset adhesive.
14. A carpet tile as claimed in claim 11, wherein the adhesive is present at a level of less than or equal to 100 oz/yd<sup>2</sup> (3395 g/m<sup>2</sup>).
15. A carpet tile as claimed in claim 14, wherein the adhesive is present at a level of 35-90 oz/yd<sup>2</sup> (1188 - 3055 g/m<sup>2</sup>).



16. A carpet tile as claimed in claim 11, wherein the adhesive material comprises a hot melt adhesive.
17. A carpet tile as claimed in claim 16, wherein the hot melt adhesive is present at a level of 36 – 50 oz/yd<sup>2</sup> (1222 – 1697 g/m<sup>2</sup>).
18. A carpet tile as claimed in claim 11, wherein the adhesive material comprises a polyolefin based thermoplastic hot melt adhesive.
19. A carpet tile as claimed in claim 11, wherein the adhesive material comprises a polyurethane thermoset adhesive.
20. A carpet tile according to any one of claims 2 to 19 in which the foam cushion comprises polyurethane rebond.
21. A carpet tile as claimed in claim 20, wherein the rebond foam cushion is characterised by a density of 20 lbs. per cubic foot (321 kg/m<sup>3</sup>) or less.
22. A carpet tile as claimed in claim 21, wherein the rebond foam cushion has a density of 12 lbs per cubic foot (193 kg/m<sup>3</sup>) or less.
23. A carpet tile as claimed in claim 22 wherein the rebond foam cushion has a density of 6 to 12 lbs per cubic foot (96 to 193 kg/m<sup>3</sup>).
24. A carpet tile as claimed in claim 23, wherein the rebond foam cushion has a density of 8 to 12 lbs per cubic foot (128 to 193 kg/m<sup>3</sup>).
25. A carpet tile as claimed in claim 20, wherein the rebond foam cushion is characterised by an uncompressed chip size of 20 mm or less.
26. A carpet tile as claimed in claim 25, wherein the rebond foam cushion has an uncompressed chip size of 15mm or less.
27. A carpet tile as claimed in claim 26, wherein the rebond foam cushion has an uncompressed chip size of 10mm or less.
28. A carpet tile as claimed in claim 27, wherein the rebond foam cushion has an uncompressed chip size in the range of 4 to 10mm.
29. A carpet tile as claimed in claim 20, wherein the rebond foam cushion is characterised by a thickness of 2 to 20 mm.
30. A carpet tile as claimed in claim 29, wherein the rebond foam cushion has a thickness of 2 to 7mm.

31. A carpet tile as claimed in claim 30, wherein the rebound foam cushion has a thickness of 4mm.
32. A carpet tile as claimed in claim 12 in which the foam cushion comprises rebound and wherein said layer of adhesive material substantially permeates and covers the layer of reinforcing material and extends in bonding relation between said carpet and said rebound foam cushion such that said carpet and said rebound foam cushion are adhesively bonded to one another by said mass of adhesive material.
33. A carpet tile as claimed in claim 32, wherein said carpet is a tufted or bonded carpet and wherein said layer of adhesive material extends between said rebound foam cushion and the underside of said carpet.
34. A carpet tile as claimed in claim 20 comprising a carpet which is formed of carpet fabric having a pile side and a base with a plurality of pile forming yarns projecting outwardly from the pile side, a rebound foam cushion layer disposed at a position below the carpet; and a bridging composite extending in bonding relation substantially between the base and an upper side of the rebound foam cushion layer wherein the bridging composite consists essentially of a layer of stabilising material having a first side and a second side, a first layer of at least one resilient adhesive extending away from the first side of the stabilising material into contacting relation with the base and a second layer of at least one resilient adhesive extending away from the second side of the layer of stabilising material into contacting relation with the upper side of the rebound foam cushion layer such that the layer of stabilising material is bonded between the first and second layers of resilient adhesive at a position between the base and the rebound foam cushion layer.
35. A carpet tile as claimed in claim 34, wherein the carpet fabric is a tufted carpet and wherein the base comprises a backing and a layer of adhesive pre-coat extending across the underside of the backing.
36. A carpet tile as claimed in claim 35, wherein the adhesive pre-coat comprises at least one of a latex and hot melt adhesive.
37. A carpet tile as claimed in claim 34, wherein the combined mass of the first layer of at least one resilient adhesive and the second layer of at least one resilient adhesive is not greater than 100 ounces per square yard (3395 g/m<sup>2</sup>).
38. A carpet tile as claimed in claim 34 in which the first and second layers of adhesive are the same type of adhesive.
39. A carpet tile as claimed in claim 34 in which the cushion thickness is between 0.04 and 0.5 inches (1 and 12.7 mm).

40. A carpet tile as claimed in claim 39, in which the cushion thickness is between 0.04 and 0.2 inches (1 and 5.1 mm).
41. A carpet tile as claimed in claim 29 or claim 40 in which the cushion weight is less than 30 oz/yd<sup>2</sup> (1018 g/m<sup>2</sup>).
42. A carpet tile as claimed in claim 2, wherein the foam cushion is a compressed particle foam and has a compressibility of less than 100% of the foam thickness at 40 psi (2.7 bar).
43. A carpet tile as claimed in claim 2, wherein said foam cushion is at least one of a cut, slit and peeled foam.
44. A carpet tile as claimed in claim 2, wherein the foam cushion has a recycled content of at least 80% by weight.
45. A carpet tile as claimed in claim 44, wherein the foam cushion has a recycled content of at least 85% by weight.
46. A carpet tile as claimed in claim 2, wherein said foam cushion comprises an open celled foam comprised of open celled foam particles bonded together.
47. A carpet tile as claimed in claim 46, wherein the open celled foam is comprised of foamed polyurethane.
48. A carpet tile as claimed in claim 2, wherein said foam cushion is substantially free of any filler.
49. A carpet tile as claimed in claim 1, wherein said binder contains at least one additive selected from flame retardant, anti-bacterial, colour, anti-microbial, anti-fungal, conductive, anti-static, fibres, magnetic material and combinations thereof.
50. A carpet tile as claimed in any preceding claim, wherein the tile has an overall height of less than 12 mm.
51. A cushion backed carpet tile according to any preceding claim which includes more than one layer of foam.